FAIRMOUNT WATER WORKS:
THE SURPRISING HISTORY
OF AN AMERICAN LANDMARK

by Jane Mork Gibson and A. Leonard Pundt

Working draft

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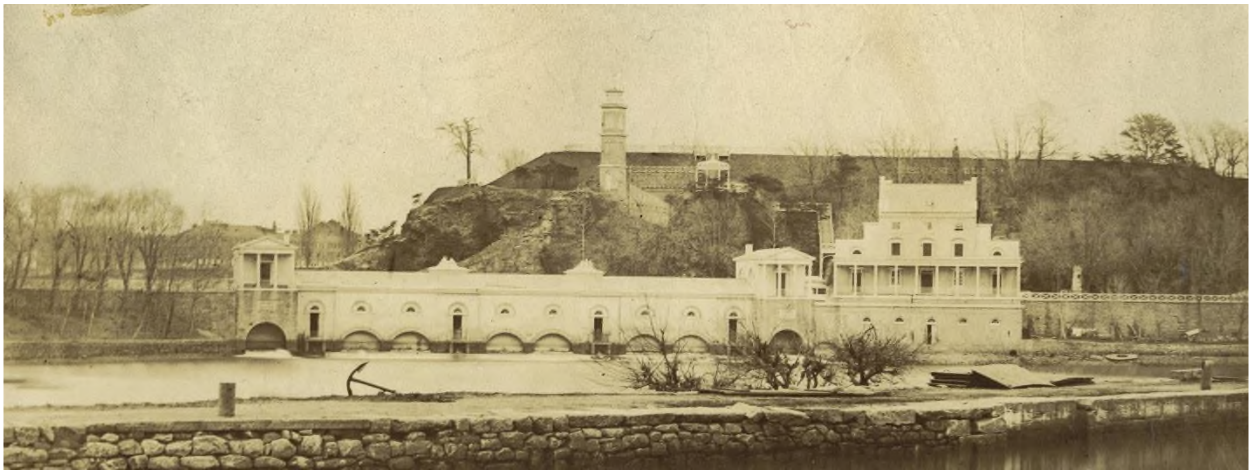
15 Jun 2024

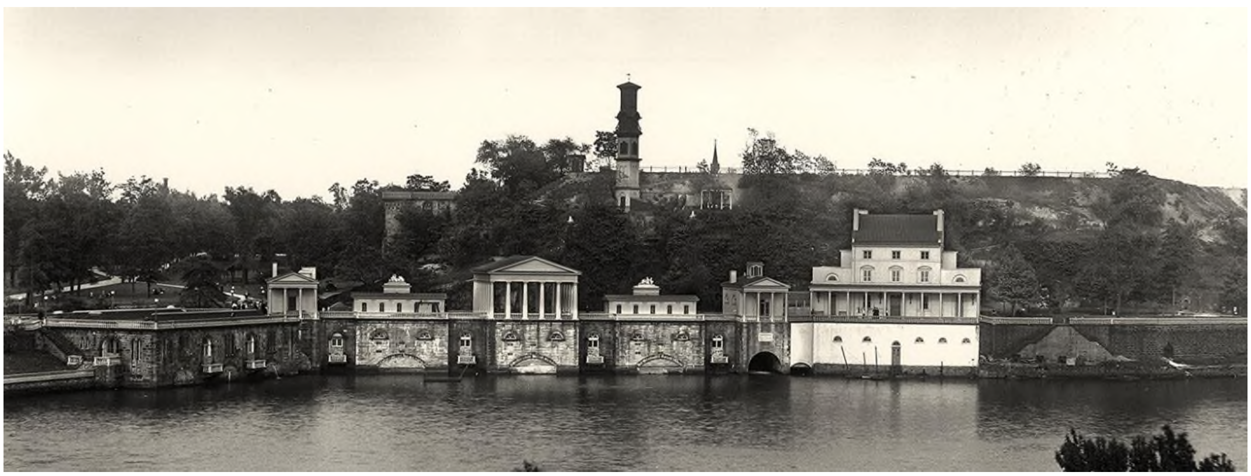
A project funded partially by the

PHILADELPHIA WATER DEPARTMENT

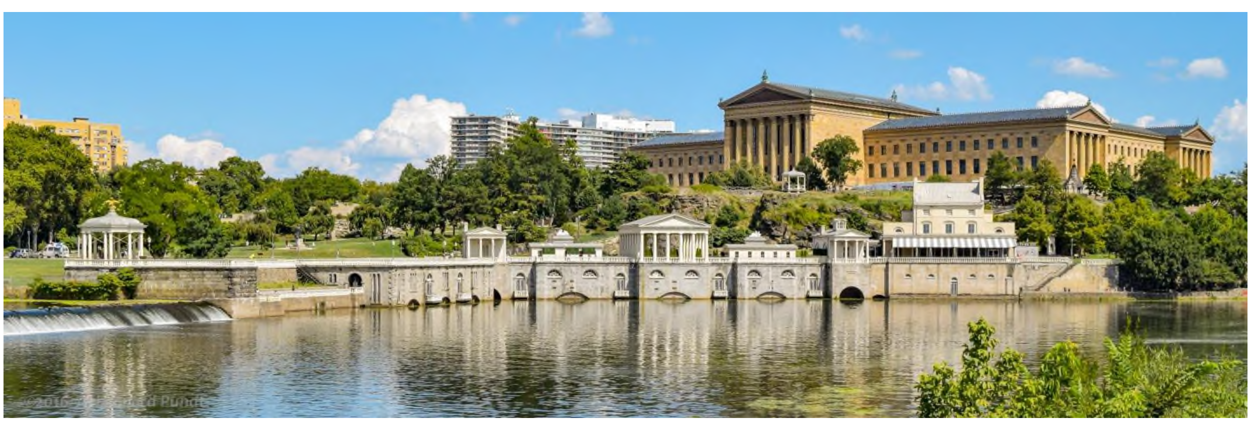
FAIRMOUNT WATER WORKS



1855 James McClees, *The Waterworks, Fairmount, Philadelphia* (1855), courtesy Library of Congress.



1910 Courtesy Philadelphia Water Department.



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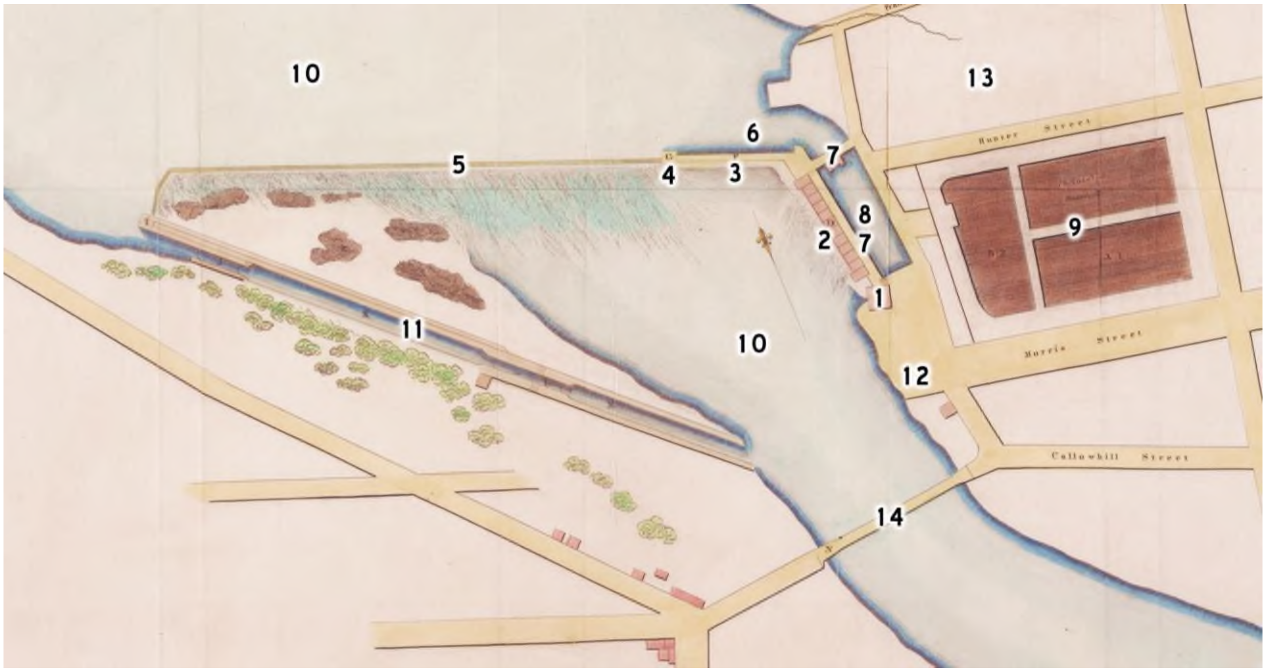
PLAN VIEW OF FAIRMOUNT WATER WORKS IN 1825



Frederick Graff, *Plan of Fairmount Water Works* (1825), courtesy Free Library of Philadelphia.

1. Engine House
2. (Old) Mill House
3. Mound Dam (later location of New Mill House)
4. Pier
5. Fairmount Dam
6. Outer Forebay
7. Forebay Bridge
8. Inner Forebay
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10. Schuylkill River
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12. Future location of South Garden
13. Future location of North Garden
14. Colossus Bridge (later Wire Bridge, Callowhill Street Bridge, and Spring Garden Street & Martin Luther King, Jr. Drive Bridges)

PLAN VIEW OF FAIRMOUNT WATER WORKS IN 1874

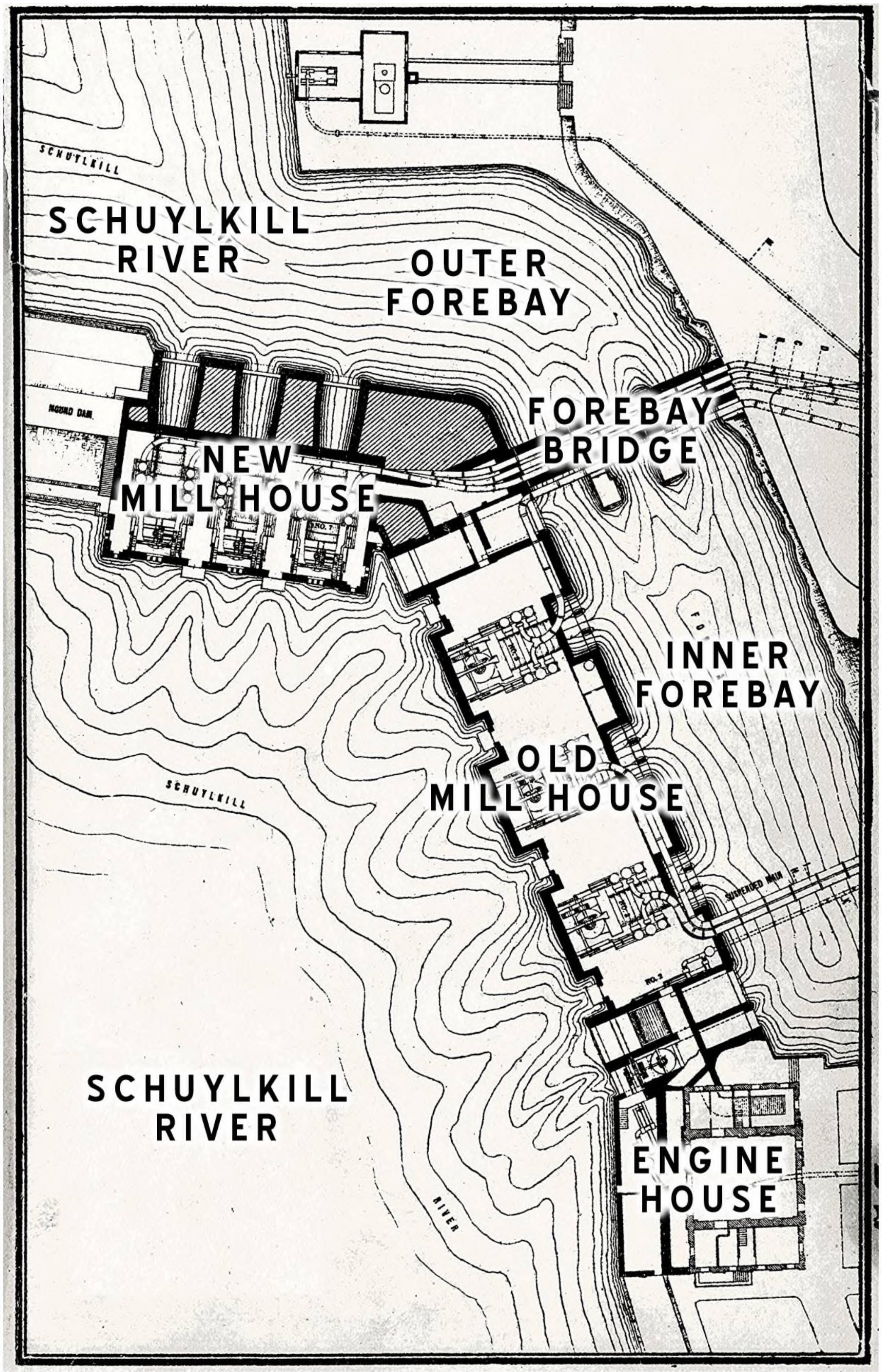

Diagram from Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), courtesy Philadelphia Water Department.

FAIRMOUNT WATER WORKS TODAY

(with dates indicating completion of structures)

Personal collection A. Leonard Pundt.

1. Schuylkill River
2. Engine House (1815)
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PREFACE

Jane Mork Gibson was a talented researcher and historian. She was born in Texas but grew up in the Boston area. After earning an associate degree in business and working for a time at the Harvard Business School, she and her husband raised a family in the Philadelphia area. While earning a B.A. and M.A. from the University of Pennsylvania, Jane began to prove herself an able historian, contributing to a landmark report on the Fairmount Water Works for the Historical American Engineering Record (often called "the HAER Report") in 1978 and creating a well-received catalogue for an exhibit on the Fairmount Water Works at the Philadelphia Museum of Art in 1986. She served as the principal or contributing historical consultant on numerous projects and studies in Philadelphia and throughout the Pennsylvania, New Jersey, and New York region.

A founding member of the Oliver Evans Chapter of the Society for Industrial Archeology, Gibson loved the history of technology and technological change in Philadelphia. She seemed to have a special fascination for the Fairmount Water Works with its history of engineering challenges, brilliant solutions, international acclaim, political drama, radical adaptation to changing needs, and cycles of decline and renewal. In addition to her work on the HAER Report and Art Museum catalogue, she wrote numerous research reports on the subject for the Philadelphia Water Department and Fairmount Park Commission. Her contribution over the years was instrumental in the effort to preserve and restore the Fairmount Water Works for future generations.

Jane had been working on a comprehensive history of the Fairmount Water Works when she died in November 2016 at the age of 93. Although a rough draft was substantially complete,

Jane passed away before she could finish it. One of the things left undone was the inclusion of the complete complement of citations which would increase the work's usefulness to other historians.

About the same time, I had been asked independently by the Philadelphia Water Department's Historian Consultant, Adam Levine, to help out with a project to catalogue as many images of the Fairmount Water Works as possible, in an online database that would be searchable by key word, date, creator, and description. In order to accurately date the thousands of images we eventually worked with, I developed a fairly detailed historical timeline of events and changes at Fairmount. To ensure the accuracy of the dating, I created source citations for virtually every piece of information.

A group who had worked with Gibson over the years then asked me to edit Jane's draft manuscript into a publishable form. I was asked to do two things: First, provide cultural, municipal, and political context for Fairmount's history. In other words, describe the *why,* in addition to the *what*. Truth be told, Jane was never very interested in that. Second, find and provide source citations for everything included in the finished manuscript, emphasizing primary sources. This would maximize the usefulness of the work to future historians.

What I initially thought would take a year or two turned out to be a much longer period of time. The more I researched, the more it seemed there was to discover that had previously been hidden. I trust my amplification has done justice to Jane's work. Regarding the footnotes, someone has remarked that they are a world unto themselves. Some readers will likely enjoy mining them for much fascinating additional information.

A note regarding naming and other conventions

Many of the terms for structures and other features at the Fairmount Water Works have become standardized, but historically this was not always the case. What we today call the New Mill House, for example, was at various times called the new wheel house, north wheel house, north mill house, or mound-dam mill house, among other designations, with inconsistent capitalization or none at all. Throughout the book, I have usually called features by their current, standardized names, except where they first appear in the narrative. In such cases, explanation is provided.

Here is a list of the standardized names of selected features. One clue that they are being used is that they are capitalized in the text.

- Balustrade
- Caretaker's House
- Central Marble Fountain
- Cliffside Paths
  - North Cliffside Path
  - Central Cliffside Path
  - South Cliffside Path
- Distribution Arch
- Engine House
- Entrance Houses
  - North Entrance House
  - South Entrance House
- Esplanade

Fairmount

Fairmount Water Works

Fairmount Dam

Fairmount Reservoir

  Basin 1, 2, etc. (numbered divisions within Fairmount Reservoir)

Forebay

  inner Forebay

  outer Forebay

Forebay Bridge

Mound Dam

New Mill House

North Garden

Old Mill House

Pavilions

  Eagle Pavilion

  Mercury Pavilion

  Pavilion (elsewhere sometimes called Grand Pavilion)

  Rustic Pavilion

Pier

South Garden

Standpipe

Stone Arch Bridge

Turbine 1, 3, etc. (numbered Jonval turbines)

Watering Committee Building

Wheel 1, 2, etc. (numbered breast wheels)

I have generally rounded dollar figures to the nearest dollar. In an attempt to provide some sort of modern correlation, I have generally included footnoted comparisons with current approximations adjusted for historical annual inflation. The current equivalent dollar amounts are necessarily very rough approximations based upon historical inflation data and are generally rounded to the nearest hundred in cases under a million dollars, and the nearest hundred thousand in cases over a million dollars.

ACKNOWLEDGEMENTS

Although the amount of research that can be done online today is astounding—it is a far different world than the one in which Jane Mork Gibson had to use tools such as note cards and pay-photocopiers—something like this could not have been done solely from a desk. I've worked most closely with Philadelphia Water Department's Historian Consultant Adam Levine and its now-retired Manager of Public Education, C. Drew Brown. Were it not for their confidence and patience, this book simply would not have been brought to publication. Both Adam and Drew provided encyclopedic historical knowledge, key insights, access to records, and kind encouragement.

Others who provided valuable assistance along the way were the late Ed Grusheski, the first director of the Fairmount Water Works Interpretive Center, and Mark Thompson, who has provided much through the years toward the activation and adaptive reuse of the Fairmount Water Works.

Thanks as well must go to Theresa Stuhlman, Michelle Ziogas, and Alina Josan at Philadelphia Parks & Recreation for their providing unrestricted access to their extensive records. Michelle and Alina were, in turn, the Archivist at the Fairmount Park Historic Research Archives. Theresa opened the archives to me when there was no archivist around. Their generosity of time and patience through multiple visits to the Archives was indispensable. Michelle was especially helpful in that regard.

One of the challenges I encountered while researching the project was how little actual information is contained in modern official sources. Annual reports since the 1980s, for example, have become more promotional than descriptive. For this reason I have had to rely more on

newspaper accounts and, especially, the recollections of those involved for specifics of the narrative in the modern era. Among those to whom I am indebted for allowing me to interview them are Joan Becker, Drew Brown, Ed Brown, Lance Butler, Ann Clausen, Stephanie Craighead, Joanne Dahme, Claire Donato, Bill George, Steve Feldman, David Hollenberg, Meg Holscher, Craig Johnson, Michael Karloutsos, Adam Levine, Bill Marrazzo, Christine Mattheu, Bill Mifflin, Joe Perillo, Victoria Prizzia, Garrett Selby, Gary Siegel, Marilyn Sprague, Lucy Strackhouse, Shane Stratton, Jan Supco, Joseph Syrnick, Mark Thompson, Gail Tomlinson, and Karen Young.

Adam Levine's "Philly H_2O" website and Morris A. Pierce's online survey of water systems have both been invaluable sources of useful links and leads to a great many valuable documents.

Thank-you to Adam Levine, Drew Brown, and the Oliver Evans Chapter of the Society for Industrial Archeology's Muriel Kirkpatrick for reviewing the manuscript and offering helpful suggestions.

I must offer particular appreciation to Ann Cullen, Jane's daughter, for allowing me the privilege of stepping into her mother's shoes. Her kind permission and patience has not been regarded lightly. I trust her confidence has not been misplaced.

Lastly, thank-you to my wife, Jeanne, who so graciously tolerated my endless investigation of the history of the Fairmount Water Works and endured many tellings (and retellings) of some interesting anecdote or historical detail I had recently managed to unearth, as well as for her encouragement and patience, manifest in putting up with boxes of research materials in the garage, in the cellar, in the dining room, and even in the bedroom (before finally being collected into my office), not to mention books bristling with Post-It® notes at all angles,

piled at times on the kitchen table, living room end tables, and anywhere else I could find a spare surface.

A. Leonard Pundt

15 Jun 2024

INTRODUCTION

Consider for a moment the place where you live and the people around you. Think about your family, neighbors, co-workers, the people you pass on the street and see in the supermarket, the people you see at church, or perhaps at your kids' sports and school events. Now imagine that for every ten you know, for every ten you pass or bump into or greet, for every ten you see, one is now dead—gone, buried, with family and friends grieving. One out of ten of your family, one out of ten of your neighbors, one out of ten of your friends, co-workers, acquaintances, your children's classmates, restaurant waiters and waitresses, store employees, wherever you look, all over the area where you live. And more are sick. All from an unknown cause.

Death seems to be everywhere and with it, its perpetual companion, fear.

People are afraid that any bad odor or rotting trash could make them mortally sick. Bad enough for yourself, but you're more fearful for your children and family members. How can you keep them safe?

What are those beyond your family likely to be thinking and feeling? What pall of mourning and dread would be cast over the community? With the experts divided over the cause, fear causes people to seek something or someone to blame. What scapegoats would start to emerge? What would people be demanding of their leaders?

What is it like on the street? How do people interact as they pass each other—with sideward glances and a hurrying on past? Are nervous fingers pointed at anyone who coughs or sneezes? How do you protect yourself and your loved ones from not just the disease but other people's fears?

How do you react? Your first thought might be to flee. Well and good if you are wealthy.

You can pack up your family and move to your summer home in the nearby countryside or visit friends living elsewhere. Many do.

If you are a middle-class business owner or shop keeper, say, you might be able to leave town, but who would run your business in the meantime? Could you afford to lose so much income? Perhaps if it were just you, but you've got a family to support and possibly employees to look after.

If you're a tradesman or an unskilled worker, however, leaving is just not an option. If you do that, good luck finding work. You definitely cannot afford the loss of income. How would you pay for a second place to put up your family? How would you keep them fed and clothed? No, you're going to have to make do where you are. But how? Simply hope for the best?

This atmosphere of terror was Philadelphia in the summer of 1793 and the disease was yellow fever.

If this sounds like the recent COVID-19 pandemic, it was locally much worse. By that autumn, just about one out of every ten people had died and many more had been sickened. The population was literally decimated. Experts debated the cause, but no one was certain. People were afraid to greet each other on the street. City, state, and federal government shut down as those with means fled to outlying areas to avoid getting sick. Commercial activity was virtually paralyzed. Residents demanded their leaders do something, anything.

Between 1793 and 1802, the city suffered seven more epidemics of yellow fever—in 1794, 1797, 1798, 1799, 1802, 1803, and 1805—with the outbreak in 1798 being almost as serious as the first.

This is the story of how the people of Philadelphia responded to the crisis, how they

worked together to find solutions to difficult problems. It’s also a story of how, as time went on and new problems arose, the people of Philadelphia adapted the original solutions to the new challenges. It’s a story of people, politics, changing times, and changing attitudes, of opportunities seized and opportunities lost. Finally it’s a story of the recognition of the importance of history and the need for retelling that history in an engaging way so that lessons may be gleaned for the future.

CHAPTER 1

CRISIS AND RESPONSE

Philadelphia in the 1790s was not large by today's standards. If you were transported to the corner of 2nd and High Streets,[1] you would be forgiven for thinking you had landed in a good-sized town, not a city. Its population of 28,522 was small by European standards. London had a population of approximately one million[2] and Paris had grown to 524,000.[3] Philadelphia was large, however, by the standards of its place and time. It was the second largest city in the nascent United States, behind New York which stood at 33,131. Boston and Baltimore trailed Philadelphia at 18,320, and 13,503, respectively.[4] At the moment it was serving as the new nation's capital, a role it would play until 1800. It was a center of commercial activity and the intellectual hub of the country. In addition to strong merchant and artisan classes, the city was on the cusp of forming a robust manufacturing class, something the young Republic had not seen before.

Standing on the corner of 2nd and High Streets, you would notice immediately before you a series of long market sheds lined up in the middle of High Street and stretching to the west for blocks, with merchants and their customers crowding around. Although High Street, as the primary east-west thoroughfare, is about 100 feet wide and has generous sidewalks, the markets nearly fill the street at its eastern end and give it a rather congested feel. If you turn to look

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[1] After 1800, High Street began informally to be called Market Street. In 1853 City Councils made the change official. See Joseph Jackson, *America's Most Historic Highway* (Philadelphia: 1926), 3.
[2] "A Population History of London," *The Proceedings of the Old Bailey* (Mar 2018), <https://www.oldbaileyonline.org/static/Population-history-of-london.jsp>, accessed 1 Apr 2018; *Demographia* (2003), <http://demographia.com/dm-lom31.htm>, 2001, accessed 2 Apr 2018.
[3] *Demographia* (2003), <http://demographia.com/dm-par90.htm>, 2003, accessed 2 Apr 2018.
[4] "Population of the 24 Urban Places: 1790," *U.S. Census Bureau* (15 Jun 1998), <https://www.census.gov/population/www/documentation/twps0027/tab02.txt>, accessed 31 Mar 2018.

eastward along High Street, you would see a couple of blocks away the wharves of the seaport on the Delaware River. Berthed cheek by jowl, many of the ships' bowsprits stretch over Front Street, the north-south roadway which parallels the river along the docks. Looking back to the west, the number of businesses and residences gradually thin out as High Street stretches approximately a mile to Centre Square,[5] situated at its intersection with Broad Street. High Street continues some distance beyond Centre Square to the Schuylkill River, but this is nearly impossible to see from your vantage at 2nd Street and there is virtually no development that far west at any rate. In fact, nearly all of the city's development is clustered in a crescent-shaped area near the Delaware River. (See Figure 1-1, Map of Philadelphia in 1796.)

[55] Centre Square would be renamed Penn Square by resolution of City Councils on 19 May 1829. Today the square is occupied by City Hall. See J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. III (Philadelphia: L. H. Everts & Co., 1884), 1844.

Figure 1-1. Map of Philadelphia in 1796.

Plan of the City of Philadelphia and its Environs (shewing the improved Parts), John Hill, Surveyor and Draftsman (30 May 1796), Library of Congress.

All of the streets are arranged in a grid of right angles, roughly aligned east to west and north to south. Streets paralleling the east-west High Street are named after native trees like Chestnut, Locust, and Pine. West of Front Street, all of the north-south streets are numbered, beginning with 2nd Street and proceeding west, with the exception of the aptly named Broad Street. Although High Street and Broad Street are very wide, others are less so. The numbered north-south streets are generally narrower than those running east to west. The alleys are narrowest of all, some barely wide enough to allow the passage of a cart.

The boundaries of the City of Philadelphia[6] are the Delaware River to the east, the Schuylkill River to the west, Vine Street to the north and Cedar Street (today called South Street) to the south, enclosing an area of roughly two square miles. High Street, stretching east to west, is roughly midway between Vine to the north and Cedar to the south. Broad Street bisects the city from north to south just west of the midpoint between the two rivers. Although the western border is the Schuylkill River, nearly all of the built environment is clustered in a roughly nine-block-long half-moon shape centered on the Delaware River. There is very little development west of 6th Street, where the State House is located, and almost none west of Broad where a large wooded area had been almost entirely cleared by the British when they occupied the city during the War for Independence.[7]

The buildings around you are mostly red brick with white trim, three and four stories high, although some are wood frame. Shops and other businesses, with their proprietors' residences above, line High Street and other corridors. Other residences crowd the lesser streets.

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[6] The formal name of the City at this time was the "Mayor, Aldermen, and Citizens of Philadelphia." Although "City of Philadelphia" was not adopted until 1854, it is used throughout this book for the sake of simplicity and clarity. See "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §1 (Harrisburg: Boyd Hamilton, 1854), 21.

[7] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 172.

Many of these are so-called “trinities”—small, three-story houses in rows, with essentially one rectangular room to each floor. A handful of mansions dot the area. Some of the wealthier merchants and landowners maintain summer homes, mostly north and northwest of the city, to which they and their families escape during the often oppressively hot and humid Philadelphia summers.

Horses, wagons, and people on foot stream everywhere. The streets are paved with pebbles and pea gravel and edged with brick sidewalks separated from the stream of traffic by wood bollards. The gutters, usually made of brick but sometimes of wood, are filled with animal waste, rotting garbage of various vegetable and animal origin, the contents of chamber pots tossed from upper floor windows, and the odd dead animal waiting to be carted away. Despite the willow, poplar, and buttonwood trees which lined the streets, one’s nostrils are constantly assailed by the pungent aromas of decomposition, manure, urine, and human waste, not to mention body odor. This heady bouquet is especially “piquant” during the summer.[8]

Since improved oil lamps were introduced in Europe less than ten years earlier and are still very expensive, virtually all residences, businesses, and workshops are lit by natural light during the day and candlelight during hours of darkness. This means that interior spaces are very dark in the evenings, especially in winter. Because of the use of candles, the threat of fire is a constant concern, since floor joists and many interior wall frames are made of wood even when exterior walls are brick.

Residential and commercial development spills out north of Vine Street and South of Cedar Street, but these areas are not part of the City of Philadelphia proper. Villages, townships,

[8] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 172f.

and districts like Northern Liberties[9] to the north (with a population of 9,913) and Southwark[10] to the south (with 5,661[11]) have grown by now into strong, if rather unruly, municipalities in their own right.[12] Taken as a whole, the total population of the settled area is a little over 44,000.

All three levels of American government operate in a cluster of buildings on one block of Chestnut Street, between 5th and 6th Streets. In New York City, one year earlier, George Washington had been sworn in as the first President of the United States under the new U.S. Constitution, which had been created in 1787 and ratified by the states in 1788. At this time, both houses of Congress are in the midst of relocating from New York. When finished with the move, the Senate and House of Representatives will meet in the renovated county courthouse at the corner of 6th and Chestnut. (The President will reside a block away at 6th and High Streets.) The Pennsylvania Assembly conducts its affairs in the middle of the block in the Pennsylvania State House.[13] The Philadelphia city government operates in City Hall on the corner of 5th and Chestnut Streets.

The city's government consists of a mayor, bicameral legislature, Board of City Commissioners, and registrar. The upper chamber of the legislature, called the Select Council, consists of 12 members; the lower chamber or Common Council is composed of 20. Members of both Councils are popularly elected annually. The mayor is elected annually by the members

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9 A remnant of the "liberty lands," an area surrounding Philadelphia, in which William Penn granted free plots of land as a bonus to those who purchased larger tracts in the city or the interior of Pennsylvania.
10 Pronounced "SOUTH-werk." See Noah Webster, "Geographical Vocabulary, Etc.," *Universal Pronouncing and Defining Dictionary of the English Language* (London: Ward, Lock, and Tyler, 1869), 589.
11 "Population of the 24 Urban Places: 1790," *U.S. Census Bureau* (15 Jun 1998), <https://www.census.gov/population/www/documentation/twps0027/tab02.txt>, accessed 31 Mar 2018.
12 When in the mid-nineteenth century the City of Philadelphia expanded and absorbed in one stroke these and many other municipalities within the borders of Philadelphia County, they never lost their sense of identity. Still today, Philadelphians maintain perhaps the strongest neighborhood identification among residents of any American city.
13 Known today as Independence Hall.

of the Select Council.[14]

The city's economy is driven by farming and shipping and the commercial activity resulting from exchange between the two.[15] This activity also drives growth. Between 400 and 500 houses are being added each year,[16] not to mention shops, inns, and other businesses. Despite the importance of maritime trade to the health of Philadelphia's economy—or perhaps because of it—the city's port is administered by the Commonwealth of Pennsylvania.[17] The money found in people's change purses, the currency they used for ordinary purchases, is a confusing combination of Spanish minted dollars (the most numerous), United States dollars (created five years earlier), sundry state coins, and French, Portuguese, and English gold coins.[18]

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For ages past, humans have pondered, sought, and debated the causes of disease. The ancient Greeks believed it was punishment from the gods. They also posited that many diseases came about because of imbalances between four so-called "humors"—blood, yellow bile, black bile, and phlegm.[19] According to the humoral theory of disease, being too wet or dry, or cold or hot, would upset the balance between the humors and lead to sickness. The ancient Greeks also

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[14] Historical Society of Pennsylvania, *Collection 1002, Philadelphia (Pa.), City Council, Petitions to the Select and Common Councils* (2004); Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 202, 223. After 1796, when the Pennsylvania state legislature would amend the incorporation act, the mayor would be elected by members of both chambers.
[15] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 208.
[16] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 218.
[17] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 223.
[18] The U.S. dollar was created by the U.S. Continental Congress in 1785. Its name came from the German *Thaler* (pronounced "TAH-ler"), short for *Joachimsthaler* (pronounced "WAH-keems-TAH-ler"), a coin made from silver from a mine in Joachimsthal (lit. "Joachim's Valley"). The name had previously been used as a nickname for the eight-real Spanish coin circulated in the American colonies in the eighteenth century. Minted dollar coins would not appear until the creation of the U.S. Mint in 1792. The British pound was finally phased out in 1800.
[19] The four humors corresponded to the four temperaments—sanguine (enthusiastic) for blood, choleric (decisive) for yellow bile, melancholic (analytical) for black bile, and phlegmatic (relaxed) for phlegm.

believed that disease could be caused by miasma, literally “bad air.” The miasma theory supposed that odors arising from rotting organic matter could make one sick.

The punishment-of-the-gods idea virtually disappeared by the time of the Renaissance, but the humoral and miasma theories survived well into the nineteenth century. Along the way they were joined by the filth theory. The filth theory surmised that contact with various types of filthy matter could cause disease. The miasma and filth theories were closely related. Whereas the filth theory held that disease was caused by contact with filth, the miasma theory held that bad air and odors from filth could cause sickness. Because filth often smelled bad, the public often found the two ideas difficult to distinguish.

Of the three theories of disease—humoral, miasma, and filth—the latter two were of most concern to public health officials, the former being the result of personal behavior and activity and not as responsive to public influence. The miasma and filth theories, though, were very much within the purview of public leaders. As the yellow fever epidemics raged, public officials did not instruct people much in how to balance their humors but instead grappled with how to reduce filth in the streets and eliminate bad odors wherever they may arise. Public officials divided into two camps, one that argued from the miasma theory and one that argued from the filth theory. Whatever the cause, one thing which both sides could agree on was the need for clean water for drinking and cooking, and with which to wash the streets.

Even in the years before the yellow fever crisis, the need for clean water had begun to be recognized. In the early half of the eighteenth century Philadelphia enjoyed a reputation for exceptional water. Its citizens drew water from private and public wells. As the population grew and density increased, however, the quality of the water deteriorated. The shafts under outhouses, known as privy pits, were increasingly dug near wells. Drainage from the pits, as well

as from the large number of cemeteries, found its way into the wells. In a span of 50 years, from the 1740s to the 1790s, the quality of Philadelphia's well water went from remarkably sweet to remarkably wretched.[20] As the city's population density increased, the incidence of numerous potentially fatal diseases like cholera and typhus increased as well. With the causes unknown, city leaders began to see possible links to either foul water itself or bad air arising from it.[21]

The possibility of a better water supply had been considered by Benjamin Franklin who included a warning in his will, read in 1789, along with a provision of funds for the city to develop an additional water supply system:

> And having considered that the covering of the ground plot of the city with buildings and pavements, which carry off most of the rain, and prevent its soaking to the earth, and renewing and purifying the springs, whence the water of the wells must gradually grow worse, and in time be unfit for use, as I find has happened in all old cities, I recommend, that at the end of the first hundred years, if not done before, the corporation of the city employ a part of the hundred thousand pounds [provided for in the will], in bringing by pipes, the water of the Wissahickon Creek into the town, so as to supply the inhabitants, which I apprehend may be done without great difficulty, the level of that creek being much above that of the city, and may be made higher by a dam; I also recommend making the Schuylkill completely navigable.[22]

The need for water was not just in terms of quality but of quantity as well. The threat of fire was ever present. Conflagrations in Boston in 1711 and New York City in 1776 destroyed

[20] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 5; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 13.
[21] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 10ff..
[22] Albert Henry Smith, ed., *The Writings of Benjamin Franklin*, collected with a Life and Introduction (Macmillan Co., New York, 1907), 506. See also Benjamin Franklin Will, June 23, 1789. Quoted in Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 6f.

large portions of those cities. Volunteer fire companies had been formed but they were often hampered by a shortage of water during summer dry spells and freezing temperatures during the winter. As the population grew, people began to clamor for both more and better water.

In 1792 the Pennsylvania Governor Thomas Mifflin signed into law an act incorporating the Delaware and Schuylkill Canal Company. [23]The project was envisioned as the easternmost portion of a system of transportation links that would stretch from the Delaware River at Philadelphia to the Ohio River at Pittsburgh, opening up the interior of Pennsylvania and regions to the west to commerce benefiting Philadelphia and the Commonwealth of Pennsylvania. A secondary function of the canal would be to supply the city with additional water.

Parts of the canal were constructed in Philadelphia and Norristown, but construction crews encountered difficulties between the two ends. The two competing aims of the project—provide for inland navigation as well as supply water to Philadelphia—meant that the canal needed to be built on the geologically unsuitable east side of the Schuylkill River rather than the west side originally recommended by engineers. Chronically underfinanced, the company did not need much to push it into insolvency. The major investors pleaded for additional capital[24] from both the Commonwealth and the City of Philadelphia, but neither was eager to help. A lottery[25] organized to raise funds failed and work on the canal was suspended in 1795.[26]

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[23] Robert Morris et al., *An Historical Account of the Rise, Progress and Present State of the Canal Navigation in Pennsylvania* (Philadelphia: Zachariah Paulson, 1795), 33ff, courtesy Evans Early American Imprint Collection, <https://quod.lib.umich.edu/cgi/t/text/text-idx?c=evans;idno=N22323.0001.001>, accessed 26 Aug 2022.

[24] Robert Morris et al., *An Historical Account of the Rise, Progress and Present State of the Canal Navigation in Pennsylvania* (Philadelphia: Zachariah Paulson, 1795), 65, 72f, courtesy Evans Early American Imprint Collection, <https://quod.lib.umich.edu/cgi/t/text/text-idx?c=evans;idno=N22323.0001.001>, accessed 26 Aug 2022.

[25] Delaware and Schuylkill Canal Company, *Canal Lottery; Scheme of a Lottery Authorized by an Act Entitl'd…* (Philadelphia: Zachariah Paulson, 1795), courtesy Evans Early American Imprint Collection, <https://quod.lib.umich.edu/cgi/t/text/text-idx?c=evans;idno=N22322.0001.001> accessed 26 Aug 2022.

[26] The Delaware and Schuylkill Canal Company ultimately merged with the Schuylkill and Susquehanna Canal Company to create the Union Canal Company. Successful where its parent organizations were not, the Union Canal Company eventually built the Union Canal between Reading on the Schuylkill River and Middletown on the Susquehanna River. Completed in 1828, the canal provided an early eastern link in the great chain of transportation

While water proposals came and went, funding sources were debated, and promising enterprises foundered, the series of yellow fever epidemics brought the issue of water supply to a head.

In August of 1793, physicians in Philadelphia began to notice increased cases of a horrifying malady. The disease was not unknown. Periodic outbreaks had previously occurred from time to time, perhaps as far back as 1699, but the last of these was thirty years earlier[27] and this new wave appeared especially furious. A modern description shows the disease was not gentle with its victims:

> Initial symptoms include aches and pains, fever, nausea, and dizziness, lasting several days before receding. In serious cases, the symptoms return with renewed intensity as the disease spreads to the liver, inducing jaundice [yellow coloration of the skin], delirium, and internal hemorrhaging. The victim begins bleeding from the ears and nose, retching up a blend of gastric contents and blood known as the "coffee grounds" or "black vomit." In the terminal phase, the victim falls comatose as his organs and circulatory system begin to fail, usually expiring as the liver or kidneys finally give out, some 7–10 days after the relapse.[28]

Dr. Benjamin Rush, Philadelphia's leading physician, had seen this disease before and had studied diseases like it. A signer of the Declaration of Independence and champion of the United States Constitution, Rush—now in his late forties—was a private physician as well as a clinical researcher and medical professor at the University of Pennsylvania. He declared it to be a

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between Philadelphia and Pittsburgh which also included the Allegheny Portage Railroad over the Allegheny Mountains in central Pennsylvania. Bypassed in 1834 by the Philadelphia and Columbia Railroad and in 1857 by the Lebanon Valley Railroad, the canal succumbed to the competition in 1885. The Union Canal featured a tunnel drilled and blasted through solid rock at Lebanon. Still surviving, it is the oldest extant transportation tunnel in the United States. Today the tunnel is watered, as is a reach of the canal on either end; the Lebanon County Historical Society conducts canal boat tours through the National Historic Civil Engineering Landmark on summer weekends.

[27] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 181. There had been an outbreak in 1762.

[28] Simon Finger, *Yellow Fever and National Politics in the 1790s* (Philadelphia: University of Pennsylvania Press, 2011).

return of “bilious remitting yellow fever.”[29]

This time around, nearly half of all victims died. (See Figure 1-1 for a map of the geographical concentration of deaths from the disease.) The social impact was enormous. People avoided each other in the streets. City,[30] state, and federal government were all suspended and commercial activity virtually ceased as some 23,000—nearly half the area’s population—fled.[31] Governor Mifflin departed during the summer. President Washington left in September, returning on the first of November to Germantown against advice to set up a temporary office and meet with his cabinet. The mayor, 60-year-old Matthew Clarkson, remained at his post despite the danger. As the city government withered around him, Clarkson eventually governed through a volunteer committee of leading citizens who bravely stayed as well.[32]

In effect, the city shut down for three months. Businesses could barely operate, with so many employers and employees either out of town, sick, or dead. Shipping activity ceased as other cities quarantined all goods from Philadelphia’s port. Food became scarce as farmers refused to travel into the city to sell their produce and livestock. Only one newspaper was able to continue publishing. Families were ravaged; there were heart-rending accounts of abandonment of wives by husbands and children by parents. With the breakdown of civil order a looming possibility, the disruption to society was incalculable.[33]

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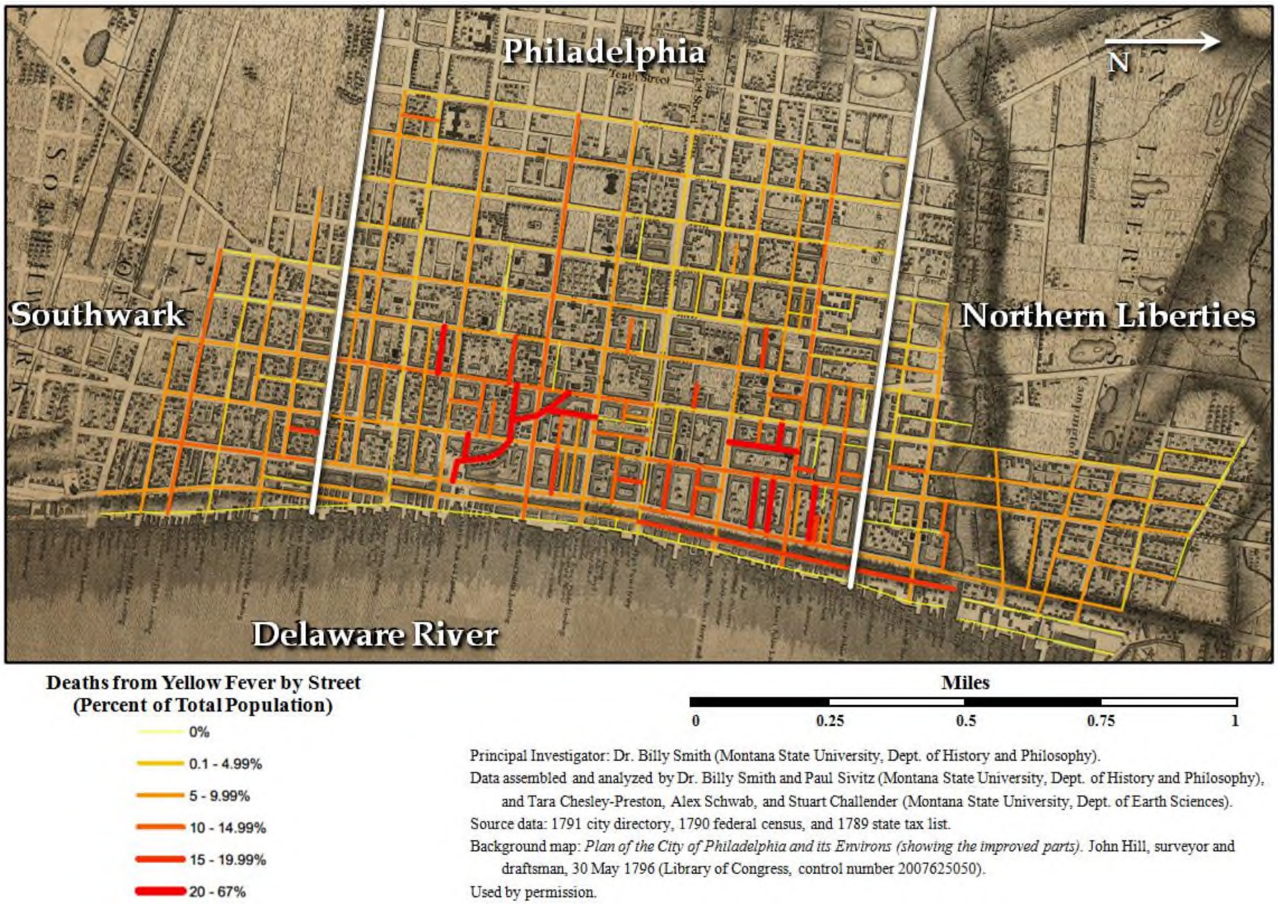
[29] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 181.
[30] *Minutes of the Common Council of the City of Philadelphia, Fair Copy book, 18 Jan 1793–3 Oct 1796*, 21. “No meetings between end of August and beginning of December[. L]ast meeting august 28, 1793 refers to the malignant fever in the city. Next recorded meeting on December 2, 1793—but no quorum…” See also *Minutes of the Common Council of the City of Philadelphia, Fair Copy book, 18 Jan 1793–3 Oct 1796*, 25, 26f, 28f, 31.
[31] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 5.
[32] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 181, 188.
[33] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 185.

Figure 1-1. Map of Philadelphia, showing yellow fever mortality in 1793.



It wasn't until November that the crisis abated, those who fled returned, and the normal activity of the city began to pick up again. By then approximately 5,000 people had died, perhaps more—one tenth of the combined population of the city and nearby areas[34]—and many more had

[34] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 187f; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 5f, 34, 36; Simon Finger, *Yellow Fever* (Philadelphia: University of Pennsylvania Press, 2011); "The Yellow Fever Epidemic in Philadelphia, 1793," *Contagion: Historical Views of Diseases and Epidemics* (Harvard University Library Open Collections Program, 2018), <http://ocp.hul.harvard.edu/contagion/yellowfever.html>, accessed 19 Mar 2017; U.S. Census Bureau, *Population of the 24 Urban Places: 1790,* <https://www.census.gov/population/www/documentation/twps0027/tab02.txt>, 15

been debilitatingly sickened.

Cooler temperatures eventually curtailed the outbreak that year, but the disease wasn't finished with the city. Philadelphia was lashed seven more times by yellow fever in the next few years—in 1794, 1797, 1798, 1799, 1802, 1803, and 1805.[35]

By 1997, as yellow fever made its third appearance in five summers, Philadelphians clamored for city officials to investigate the means of providing a cleaner and more copious supply of water. On 2 Nov 1797 the Select Council resolved:

> That a Committee be appointed (to join a Committee of the Common Council in case they see fit to appoint One) to consider of & report a plan for supplying the City with a sufficient quantity of Water from the Rivers Delaware or Schuylkill or the Wisshicon [*sic*] Creek & that they annex to their report the most probable Estimates they can procure of the Expence [*sic*] which will attend the same. Resolved that the same Committee be instructed to make an application to the managers of the Delaware & Schuylkill Canal Company for information as to the time when they expect to be able to supply the City with a sufficient quantity of water by means of their Canal.[36]

In other words, the Select Council did what government bodies always seem to do: it created a committee. The group would investigate (on its own or jointly with a committee from

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Jun 1998, accessed 31 Mar 2018; and U.S. Census Bureau, *Population of the 33 Urban Places: 1800*, <https://www.census.gov/population/www/documentation/twps0027/tab03.txt>, 15 Jun 1998, accessed 31 Mar 2018. According to the U.S. Census Bureau the combined population of the City of Philadelphia, the Northern Liberties township, and Southwark district was 44,096 in 1790 (28,522, 9,913, and 5,661 respectively). The combined population grew to 61,559 in 1800 (41,220, 10,718, and 9,621 respectively). Extrapolating from these figures, the combined population in 1793 would likely be approximately 49,000. Blake claims "over four thousand deaths;" Finger cites "an estimated 5,000 lives." Weigley makes a compelling case that over 5,000 died. Conservatively assuming a number somewhere in between produces a fatality rate of approximately nine percent of the population.

[35] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 5f, 34, 36; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 197.

[36] *Minutes of the Select Council of the City of Philadelphia, 14 Oct 1796–30 Mar 1799 (Philadelphia City Archives 120.3), Book 1,* 129. Messrs. Fox, Bleakley, and Reed were appointed to serve on the Committee. See 23 November 1797 message from Common Council on concurrence and appointment of Messrs. Magoffin, Cox, and Parker, 133.

the Common Council) whether or not there was any immediate hope from the bogged down canal project and evaluate the feasibility of drawing water from the Delaware or Schuylkill Rivers as well as Franklin's idea of bringing water from the Wissahickon Creek.

City residents maintained pressure on their leaders.[37] Casting about for shorter-term solutions, the city tried to clean the streets using workers armed with flush carts, iron scrapers, and brooms. Attempts at providing additional water were made by digging new wells, purchasing new pumps, and repairing old ones.[38] The city dug waste pits in the southwest and northwest public squares[39] for the dumping of the contents of privy pits.[40] It also sought financial help by requesting the state legislature assign to the city "duties on Sales at auction"—customs collections at the port—but the request was rejected.[41]

The worst of the subsequent outbreaks was in 1798. The human suffering was almost as great as in 1793, with estimates of the number of dead between 1,200 and 3,500. Three quarters of the population fled, making the city more of a ghost town than before.[42] Other cities, such as New York and Baltimore were afflicted as well, but Philadelphia was particularly hard-hit.[43]

We now know, of course, that yellow fever is caused by a virus which is passed from person to person by mosquitoes, but this wasn't demonstrated until the 1890s by Dr. Walter Reed, working in the U.S. Army Medical Corps, after studying an 1881 proposal by Dr. Carlos

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[37] *Minutes of the Select Council of the City of Philadelphia,* 9 Jan 1798, 170.
[38] *Minutes of the Select Council of the City of Philadelphia,* 9 Jan 1798, 174.
[39] The four primary squares were renamed by City Councils on 9 May 1825. Northeast, Southeast, Southwest, and Northwest Squares became Franklin, Washington, Rittenhouse, and Logan Squares, respectively. As noted earlier, Centre Square was renamed Penn Square in 1829. See J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. III (Philadelphia: L. H. Everts & Co., 1884), 1840ff.
[40] *Minutes of the Select Council of the City of Philadelphia,* 18 Jan 1798, 180.
[41] *Minutes of the Select Council of the City of Philadelphia,* 31 Jan 1798, 187.
[42] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 6; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 197.
[43] *Contagion: Historical Views of Diseases and Epidemics,* "The Yellow Fever Epidemic in Philadelphia, 1793," Harvard University Library Open Collections Program, <http://ocp.hul.harvard.edu/contagion/yellowfever.html>, accessed 19 Mar 2017.

Finlay, a Cuban doctor.[44] Looking back with the benefit of hindsight, the virus was probably brought by ship to Philadelphia in the bloodstreams of refugees from Santa Domingo fleeing an uprising there. A wetter than usual spring in Philadelphia had created swampy areas which resulted in a profusion of mosquitoes throughout the summer. This did not go unnoticed, but because of a lack of epidemiological knowledge[45] and analytical techniques, even the most learned were unable to put the pieces together. At the time, the cause was anyone's guess—and it seemed just about anyone had one.

Ever since Benjamin Franklin had published his *Experiments and Observations in Electricity* in 1751, many Philadelphians had been interested in the unseen world around them. Some speculated that yellow fever was caused by an invisible force. It was a popular belief that thunder cleared the air of miasmas. One prominent citizen suggested that there were too many lightning rods in the city and that this helped spread yellow fever "by imperceptibly drawing off the electric fluid from the clouds and thereby preventing thunder."[46]

Some thought the cause was polluted water and miasmas arising from it. There certainly was more than enough filth in the streets to give proponents of both the miasma and filth theories plenty to support their reasoning—rotting garbage, offal, and the contents of chamber pots emptied from upper story windows. Indeed, Dr. Rush believed the initial cause was a large shipment of coffee beans that had been discarded on the waterfront in July.[47] He and other miasmists believed that foul "exhalations" from the decomposing beans started the problem.

Rotting coffee beans or no, the city's medical professionals divided into two camps, hotly

[44] "Yellow Fever," *Centers for Disease Control and Prevention* (13 Aug 2015), <https://www.cdc.gov/yellowfever/>, accessed 19 Mar 2017. The disease is transmitted by the bite of a female mosquito, primarily the species *Aedes aegypti*.
[45] Epidemiology is the study of the spread and control of disease.
[46] Ebenezer Hazard to Jer. Belknap, August 27, 1793; *From the Laboratory to the Parlor: Scientific Instruments in Philadelphia 1750-1785,* exhibit (20 April 2001–31 March 2003), Collections of Massachusetts Historical Society.
[47] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 180f.

opposed to each other. The miasmists, led by Dr. Rush, believed that noxious air was causing the disease. Others, led most prominently by a physician named William Currie, believed that the cause had a foreign source and close contact with infected persons spread the disease, beginning with the refugees from Santo Domingo. The division between the two groups was so strong that they organized themselves into rival professional societies. Those following Dr. Rush created the Academy of Medicine; the anti-Rushites joined the College of Physicians.

If treatment wasn't ineffective, it often hastened the demise of the victims. Dr. Rush prescribed an aggressive regimen of purgings and bloodlettings. Most physicians followed his drastic example. Dr. Currie and the others of the College of Physicians, however, saw more success with mild food and fresh air. Edward Stevens, a doctor from the West Indies, employed a gentle treatment he had used there. Dr. Stevens treated Alexander Hamilton and his wife, both of whom recovered. A number of French doctors who were themselves refugees from Santo Domingo, using their experience in the tropics, emerged from the Philadelphia ordeal as authorities on yellow fever.[48]

No matter which theory people subscribed to, however, there was nearly unanimous agreement that bringing more clean water into the city both for domestic use and for washing the streets would go a long way toward solving the yellow fever problem.[49] The Rushites pushed hard for it. The anti-Rushites believed it couldn't hurt and would have at least some salutary effect so they supported it as well.

Philadelphians began to demand a larger supply of clean water, believing it was the only hope against the yellow fever problem. A local newspaper editorialized:

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[48] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 185.
[49] Philadelphia City Archives, *Minutes of the Select Council of the City of Philadelphia, 14 Oct 1796–30 Mar 1799,* 120.3, Book 1, 19, 173.

> With what little expence [*sic*] and trouble might our city be preserved from the calamity which overwhelms us almost every year—an Aqueduct, which might be established at a moderate tax upon every inhabitant would render Philadelphia as healthy as the smallest country village in the state.[50]

A petition carrying hundreds of signatures was sent to the Pennsylvania state legislature, imploring it to allow the city to what it needed outside its boundaries and provide whatever financial aid would be necessary:

> If means can be adopted that can prevent a return of this desolating malady, commerce may again flourish; but if, by supineness and inattention, the necessary precautions are neglected, and the fever shall become an annual visitant, our cities must be abandoned, commerce will desert our coasts, and we, the citizens of this great metropolis, shall all of us suffer much distress, and a great proportion of us be reduced to absolute ruin.
>
> Looking forward, therefore, with trembling solicitude to the next summer, and resolving in our minds what human prudence can devise upon this most interesting occasion, we conceive it to be of essential import to the health of the city to introduce pure and wholesome water for drinking and culinary purposes, and also currents of water along the streets.[51]

The managers of the Marine and City Hospitals declared in a letter to Governor Mifflin, "The introduction of wholesome running water for domestic purposes, and for washing the streets, and common sewers, is in our judgment, an object of primary importance."[52]

On 7 Dec 1798 Philadelphia City Council requested help from the state:

> Whether this destructive enemy is introduced among us from foreign places with which

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[50] *Claypoole's American Daily Advertizer,* 19 Sep 1798. Quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 22.
[51] *Claypoole's American Daily Advertizer,* 1 Dec 1798. Quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 23.
[52] *Claypoole's American Daily Advertizer,* 18 Dec 1798. Quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 23.

> we have commercial intercourse, or whether it originates from local causes at home, divides the opinions of our physicians, and the same diversity of sentiment prevails in some degree with other classes of citizens,
>
> In this state of uncertainty, prudence dictates the propriety of guarding, in the best possible manner against both sources, & it seems generally agreed (be the origin foreign or domestic) that the introduction of good and wholesome water for drinking and culinary purposes, and for the occasional flooding of the streets of this city, will be the best means of promoting the health of its inhabitants, and of correcting the state of our atmosphere, so as to render it less recipient of contagion.[53]

And so it was that yellow fever, a disease that is not waterborne, ironically became the catalyst for the development of a clean water distribution system in the City of Philadelphia.[54]

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With construction of the Delaware and Schuylkill Canal suspended since 1795, prospects for a quick supply of additional water dimmed. A joint committee of the Select and Common Councils was commissioned on 2 November 1797 and charged with seeking ways to bring water into the city. In December, committee members met with the managers of the Canal Company to evaluate the state of the project. The managers asked for $50,000,[55] in the form of a sale of stock to the City, but even then the Canal Company would retain control over not just the water supply but the distribution system as well. The City Council committee proposed that the Canal

[53] *Aurora*, 13 Dec 1798. Quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 23.
[54] *Philadelphia City Archives, Minutes of the Select Council of the City of Philadelphia, 1796–1799,* 120.3, Book 1, 263, 265ff. For a representative resolution see entry for Thu 5 Dec 1798.
[55] The equivalent of over $1.1 million in 2022.

Company simply sell the City some fraction of the water in the canal, with the City controlling its distribution. The question at issue: Who would control the water system, a private company or the municipality? The two entities were unable to reach an agreement.

Anticipating a return of the disease, three Council members in July 1798 visited Spring Mill, on the Schuylkill River eleven miles upstream from Philadelphia, to explore the possibility of bringing to the city water from the springs in that area.[56] On 9 Aug the Common Council called for a joint committee empowered to hire an engineer to evaluate the feasibility of using water from this or any other source. The resolution also would have funded necessary actions regarding expenses of lighting, watching, watering, and cleansing the city, but city government was once again shut down by the disease—at its most intense since the summer of 1793—before the Select Council could act on the resolution.[57] It was not until 28 Nov 1798, at a meeting of the Select Council that action to investigate a new source of water for the city was authorized.[58] With an end to any serious consideration of supplying the city with water from the Delaware and Schuylkill Canal—which may or may not eventually materialize and had been determined to be insufficient in any event—the city now seriously investigated Franklin's idea of bringing water from the Spring Mill area, from Wissahickon Creek, or from any other possible source. The joint committee was appointed to "take under consideration and report the best and most practicable means of introducing an abundant supply of wholesome water into the City…"[59] It was

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[56] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 22.
[57] *Minutes of the Select Council of the City of Philadelphia, 1796–1799 (Philadelphia City Archives 120.3), Book 1,* 250. "The prevailing Contagion sickness, which afflicted the City of Philadelphia, prevented the meeting of the Select Council, after the 16th of August 1798, until the 16th day of October following…" Additionally, no meetings were held in July or the first half of August of that year.
[58] J. H. Powell, *Bring Out Your Dead: The Great Plague of Yellow Fever in Philadelphia in 1793,* (Philadelphia: University of Pennsylvania Press, 1965) 260.
[59] J. H. Powell, *Bring Out Your Dead: The Great Plague of Yellow Fever in Philadelphia in 1793,* (Philadelphia: University of Pennsylvania Press, 1965) 250.

authorized to engage "any skilfull [*sic*] & competent person or persons that they may find it necessary to employ for carrying into full & complete effect the objects of their appointment."[60] The two chambers made a joint request to the Pennsylvania state legislature for financial assistance but like others before it, the plea was rejected.[61]

By a fortunate coincidence, however, a man named Benjamin Henry Latrobe (1764–1820),[62] was in town working on the design and construction of an architecturally groundbreaking structure for the Bank of Pennsylvania.[63] The son of a British Moravian church leader of Huguenot descent,[64] Latrobe had originally intended to study for the ministry but was drawn instead to what is today known as engineering and architecture. After training under the brilliant British engineer John Smeaton, he began practicing both with other firms and on his own with some success. Fleeing to America in1796 to start afresh after his wife died in childbirth, he threw himself into pursuing independent commissions and saw his reputation grow.

The solution to the problem of providing the citizens of Philadelphia with clean water was not likely to be a simple one. Latrobe, however, was a visionary engineer at a time when one was needed and few were to be had.[65]

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[60] J. H. Powell, *Bring Out Your Dead: The Great Plague of Yellow Fever in Philadelphia in 1793,* (Philadelphia: University of Pennsylvania Press, 1965) 260.
[61] J. H. Powell, *Bring Out Your Dead: The Great Plague of Yellow Fever in Philadelphia in 1793,* (Philadelphia: University of Pennsylvania Press, 1965) 266.
[62] James F. O'Gorman, et al., *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 46; Select Council, Jan. 3, 1799, 278f.
[63] James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts, 1986), 5ff, 46ff; Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 188ff.
[64] The Huguenots were French Protestants.
[65] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 23f.

During his work on the Bank of Pennsylvania project, Latrobe had become acquainted with numerous prominent Philadelphians. Samuel Mickle Fox, the bank's president for example,[66] who had selected Latrobe's design for the new building,[67] and John Miller, Jr., another of Latrobe's patrons at the bank, were also members of the Select Council. Miller was also chairman of the Select Council's committee charged with investigating water sources and Fox was a member. Latrobe could not have failed to notice that the hot topic of how to provide the city with water was being discussed by those around him. He himself had already commented on the controversial subject of disease and its possible connection with the wells in town.[68] Miller asked Latrobe to provide an opinion on the feasibility of bringing water into Philadelphia from possible sources on the Schuylkill River above the city.[69] With characteristic boldness, on 27 Dec 1798 Latrobe personally conducted his own survey of possible water sources and sent a lengthy report to Miller on 29 Dec.[70]

The speed with which Latrobe produced his proposal was astonishing. He had traveled up the Schuylkill River and examined Spring Mill and the Wissahickon Creek[71] during severe winter weather, yet just two days later he submitted his report. His submission was not only a

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[66] *Fox Family Papers, 1755–1969* (Catalog of), Collection 2028 (Philadelphia: The Historical Society of Philadelphia, 2005), 2.

[67] Joseph M. Fox, *Growing With America: The Fox Family of Philadelphia, 1686–2006* (Xlibris, 2006) 98.

[68] Benjamin H. Latrobe, *The Journal of Latrobe: Being the Notes and Sketches of an Architect, Naturalist and Traveler in the United States from 1796 to 1820* (New York: D. Appleton & Co., 1905), 93ff; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 11.

[69] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 227.

[70] Benjamin Henry Latrobe, *View of the Practicability and Means of Supplying the City of Philadelphia with Wholesome Water,* in a Letter to John Miller, Esquire, from B. Henry Latrobe, Engineer, December 29th, 1798 (Philadelphia: A. Zachariah Paulson, Jr., 1799), in Van Horne, ed., *Correspondence and Miscellaneous Papers of Benjamin Henry Latrobe,* 4.

[71] The Wissahickon Creek empties into the Schuylkill a little over five miles upstream from what is now Center City Philadelphia.

fully fleshed-out description of his own proposal—though that would be remarkable enough—but was also a well-reasoned analysis of the various possibilities, a deprecating critique of other potential schemes, and a highly-developed, illustrated plan for carrying out his recommendation. Deciding that the sundry efforts to find an answer to the city's problem of developing a new source of water needed to be consolidated into one group, City Council on 3 Jan 1799 created a permanent joint committee, the "Committee on the Subject of Watering the City," and gave it the aggregate responsibilities of the several existing but temporary committees, including the one formed in November 1798 which John Miller, Jr., chaired. Known in short as the "Watering Committee," it consisted of four members from each Council: John Miller, Jr., Joseph Sims, John Hallowell, and Samuel Mickle Fox from the Select Council and Henry Drinker, Jr., Daniel Smith, John Rugan, and Caspar Morris from the Common Council. Thomas Pym Cope and William Parker were added in March. John Miller, Jr., chaired the new committee.[72]

The members of the Watering Committee wasted no time getting to work. They requested information from numerous sources, but had a limited response. They investigated the claims of a Mr. Huntly from Connecticut of a "valuable improvement on some of raising water from rivers to a height above their level," but no record exists other than a dismissal of his claims.[73] The Watering Committee also took a close look at Latrobe's proposal.

While Latrobe considered construction of an aqueduct to bring water from the Spring Mill area or the Wissahickon Creek, he indicated that this would need to be a second step because it would take so long to construct. Since it was desired that the project be completed as

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[72] *Minutes of the Select Council of the City of Philadelphia, 14 Oct 1796–30 Mar 1799,* 278f, Philadelphia City Archives 120.3, Book 1. Since the Philadelphia Water Department traces its lineage directly to the Watering Committee, 3 Jan 1799 is effectively the Department's date of birth.

[73] *Minutes of the Select Council of the City of Philadelphia, 14 Oct 1796–30 Mar 1799,* (Dec.18, 1798), 270; *History of Philadelphia: Philadelphia from 1794 to the Close of the Century,* 499. "Mr. Huntley of Connecticut, having been represented as a person who possessed some valuable improvements for raising water from rivers to heights above their levels, the committee of Councils was authorized to consult with him and others."

soon as practicable—if possible by August 1799 when the next yellow fever attack was expected—any aqueduct scheme would need to a secondary, follow-on project

Having dismissed the idea of obtaining water from sources above the city, the next major consideration was deciding which of Philadelphia's two rivers should be the source of the water to be pumped. Latrobe chose the Schuylkill River over the Delaware. At that time most of the settlement of the city was along the Delaware, between the river and 11th Street. As a major port city, the wharves and docks along the Delaware River were of course where maritime activities were carried on, with the attendant offloading of waste and filth from ships directly into the water. In addition, it was also the location of city markets where refuse, carcasses, and other wastes were discarded. Latrobe also thought the Delaware was more affected by the tides and the marshes it flowed past. The Schuylkill River, on the other hand, was relatively undeveloped, with very little settlement even of a private nature. With its rocky riverbed, Latrobe considered the Schuylkill to be a plentiful and healthful source of clean water. The challenge would be taking that water and distributing it throughout the city.

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Although a water-powered system was a possibility, Latrobe strongly advocated against it, declaring that relying on nature for power by employing water wheels was not advisable. He remembered London during the great fire in 1666 when the water wheels at the London Bridge waterworks could not turn to power the pumps because of the change in tides of the River Thames. In winter, there was the problem with ice. In addition he cited the heavy expense of maintaining wooden water wheel systems that rotted in the wet environment and needed frequent

maintenance and replacement. He was also against the use of cranks to change the rotary motion of a water wheel to the reciprocal motion needed for pumping. Latrobe recorded his thoughts:

> The examples of London (London Bridge Works), Versailles (Marly), and Bremen, would forever deter me from attempting works to be driven by a river subject to ice and freshes [floods]. The expence [*sic*] of keeping up the timber-work is enormous, and equal to re-building once in seven years. To give such works power, they must be unwieldy. Cranks, which are their necessary appendage, are the very worst things in mechanism.—In the Delaware or Schuylkill, the works might stand still six hours in twenty-four:—perhaps during the raging of a fire.—I once saw several houses in London burn down, while the works were waiting for the tide. This happens not unfrequently [*sic*].—In winter they would be wholly useless.[74]

Instead of using water power, Latrobe proposed a system which used steam power, similar to an arrangement employed by London's privately owned Chelsea Water Company. As Latrobe described the London operation,

> The water is received from the Thames at high-water, into several basons [*sic*] and canals, through floodgates which shut when the tide falls, and prevent its return. The water supplies the lower parts of Westminster, and is in part forced up into Hydepark [*sic*] by the engines. A smaller engine forces it still higher than the park reservoir. This reservoir and the smaller engine supply the extreme north-western part of the town. [75]

In other words, Latrobe was proposing the use of not one, but two engine houses. His plan consisted of two pumping stations, one on the Schuylkill River atop a bluff on the north side of Chestnut Street just west of Schuylkill Front Street (between today's 22nd and 23rd Streets) and

[74] John C. Van Horne and Lew W. Fornwalt, eds., *Correspondence and Miscellaneous Papers of Benjamin Henry Latrobe* (New Haven, Connecticut: Yale University Press, 1985), 141.
[75] John C. Van Horne and Lew W. Fornwalt, eds., *Correspondence and Miscellaneous Papers of Benjamin Henry Latrobe* (New Haven, Connecticut: Yale University Press, 1985), 141.

one located in Centre Square at the intersection of Broad and High Streets, each driven by its own low-pressure steam engine.

Water from the Schuylkill River would flow by gravity into a receiving basin from which it would flow, again by gravity, through a short open canal and tunnel into a deep well beneath the Schuylkill Engine House. There, a low-pressure steam engine would raise the water to just below street level and discharge it into a tunnel that would stretch approximately 3,150 feet beneath Chestnut Street to the pumping station in Centre Square. The water would flow by gravity through the tunnel and into a receiving well beneath the Centre Square pumping station where the second steam engine would pump the water from the well up to a storage reservoir near the top of the building. From the storage reservoir the water would flow by gravity down to an iron distribution chest located beneath the ground just beyond the east side of the building. The water would flow through wood pipes to recipients' homes and businesses as well as to public pumps and hydrants.[76]

Although the engine house for the station on the Schuylkill would be strictly utilitarian, for the one at Centre Square Latrobe designed an elegant marble building, envisioning it an "ornament to the city."[77] The engine house at Centre Square was planned to stand in strong contrast with the more prosaic red brick structures in most of the city. Latrobe also designed the Centre Square building to harmonize the practical with the poetic. Concealed within would be all of the machinery and equipment necessary to take the water flowing from the engine house on the Schuylkill and send it to the distribution system throughout the city.

The newly formed Watering Committee conducted its investigations with a vigorous

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[76] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 386f.
[77] Latrobe to Miller, 29 Dec 1898, 18.

sense of urgency. The city was in the grip of a recurring yellow fever epidemic; the disease may or may not return during any given summer. The committee evaluated Latrobe's proposal and other possibilities and submitted its first report to City Council on 23 Jan 1799, just 20 days after the panel was commissioned.[78]

The committee was thorough despite the speed at which it acted. In addition to Latrobe's proposal, it examined a variety of other schemes. It examined, for example, the use of water power at Morris Hill, a prominence on the Schuylkill River less than a mile up from the city that had been named "Faire Mount" by William Penn. The Delaware and Schuylkill Canal Company, however, owned the water rights there and would fight any other proposed use for the site. It also weighed and rejected the idea of obtaining water from Spring Mill, concluding that an aqueduct project would take too long and cost too much. It also considered various means of funding whichever option was to be chosen.

The Delaware and Schuylkill Canal Company, still hoping to complete its near-bankrupt canal project and fearing that acceptance of Latrobe's proposal would eliminate one of its main purposes and doom the project to failure, called the plan "a confused and enormously expensive project of '*aerial Castles,* and elevated *Reservoirs,* of different *stories,* Fountains, Baths, &c.'" and went on to belittle Latrobe's "professional abilities" as" yet *unknown,* and *untried,* so far as the history of any thing [*sic*] in his works in America has come to the public knowledge…"[79]

In the end, the Watering Committee recommended Latrobe's proposal. City Council authorized the committee to issue the necessary contracts, appoint agents of execution, purchase

[78] *Minutes of the Select Council of the City of Philadelphia, 14 Oct 1796–30 Mar 1799 (Philadelphia City Archives 120.3), Book 1,* 284, 286, 288 etc.
[79] William Smith, attr., *Remarks on a Second Publication of B. Henry Latrobe, Engineer, Said to be Printed by Order of the Committee of the Councils; (of the City) and Distributed Among the Members of the Legislature* (Philadelphia: 26 Jan 1799), 2. Emphasis original.

materials, and generally carry out what Latrobe had planned. Authorization to begin construction was given by "the Mayor and committee" on 2 Mar 1799, a mere two months and seven days from when the committee was created.[80]

Public reaction was certainly not all positive. Some, like a writer of a letter to a local newspaper, objected to drawing water from the Schuylkill River so close to the city, in a tidal area:

> Surely no man unprejudiced, or who had not an expectation of a job, would ever think of taking water from a river whose bottom is muddy, and constantly stirred up by the ebbing and flowing of the tide, when clear and pure water can be procured at so short a distance as the Falls or Wissahickon Creek, unless it can be proved that the water is more wholesome by the plentiful supply of mud with which it abounds below the falls. … Of what use will be all this immense burthen [*sic*] on the city, already much impoverished, of erecting and feeding a devouring fire engine?[81]

Others were opposed to the use of steam or simply thought the entire plan too complex and expensive. One letter-writer considered it a "ridiculous project" and hoped that:

> …the good people of my native city will be no longer duped by chimeras [mythical creatures], but they will turn out of Councils those men who have actively or, by suffering themselves to be duped by others, passively contributed to saddle the city with an unheard of expense to accomplish that which, when finished, will be a public nuisance, and the probable cause of general calamity to our city, to wit: *a reliance upon steam engines in the proper supply of water.* They are machines of all machinery the least to be relied on, subject to

[80] *Report to the Select and Common Councils on the Progress and State of the Water Works* (24 Nov 1799), 12; and Watering Committee, *1852 Annual Report* (6 Jan 1853), chart at 46. Report of 1799 states authorization to proceed was given by "the Mayor and committee" on 2 Mar 1799. The timeline in the 1852 Annual Report specifies 2 May 1799, but a handwritten note in the left margin reads, "Mch."
[81] *Philadelphia Gazette*, 14 Mar 1799; quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 34.

casualties and accidents of every kind.[82]

Philadelphia inventor and master mechanic Oliver Evans was vocal in his opposition to Latrobe's proposal.[83] He called it "the city plaything on which to expend money; more for ornament than utility, barely calculated to supply their wants without provision for a growing city."[84] Indeed, the importance of Latrobe's artistic skill as an illustrator and the impact of the professional drawings which he included in his proposal, especially those depicting the Centre Square Works, should not be underestimated.[85] Years later, recalling a conversation with Evans, engineer George Escol Sellers would write:

> [Evans] said it was Latrobe's fine drawing he exhibited of the Boulton & Watt steam engine and pumps, and above all the exterior of the pumping house, with its Doric columns and pediments, both front and rear, its center dome-shaped building covering the reservoir, with the novel expedient of the stack and chimney, terminating on the apex of the dome, vomiting its wreath of black smoke, that caught the eye of the members of the city council that adopted the plans and gave to Latrobe the superintendence of the work.[86]

Today we might say that Evans believed the members of City Council were swayed by a silver tongue and slick brochures.

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[82] *Philadelphia Gazette,* 31 Jul 1800; quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 34, and Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 66. Emphasis original.
[83] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935) 157. Evans may in fact have submitted his own proposal, but there is no known record of it extant. It may have been lost in 1809 when in a pique of frustration and bitterness Evans burned nearly all of his papers. A key ruling unfavorable to Evans by a judge in 1807 was followed in 1809 by a ruling against him by the presiding judge of the District Court in Philadelphia which included language by the judge which expressed, "in effect that a patentee was a violator of the public rights." These adverse rulings and disparaging remarks by the judges "…upon the rights of inventors coming at this time would appear to have been the last straw to Evans's overwrought mind that had led him to first bind all his papers and put them away" and later destroy them.
[84] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–40) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 38.
[85] James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 5ff, 46ff.
[86] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815-1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 38.

Whether due to better promotional materials or not, Latrobe had a large and complex project on his hands. Now came the hard part—building what he had proposed. For $6,350[87] plus expenses Latrobe was contracted as Chief Engineer to have the water works begin operations on or before 2 Oct 1799 and have the entire project fully completed by 1 Jul 1800.[88]

On the recommendation of Samuel Mickle Fox,[89] President of the Bank of Pennsylvania and member of the Watering Committee, Latrobe hired John Davis as Clerk of the Works for the construction project.[90] The oldest of ten children, Davis (1770–1864)[91] had emigrated in 1793 from Britain where he had studied and practiced architecture and engineering under the eminent neoclassical architects Samuel and James Wyatt. Although he intended to settle right away in Philadelphia, Davis instead stayed in Baltimore for year in order to avoid the yellow fever outbreak. He moved to Philadelphia in 1794 and came to Fox's attention soon after.[92]

Davis would later go on to build and manage Baltimore's water distribution system, design and construct numerous mills and factories, survey an extension of the Cumberland Turnpike, lead the turnpike's management company, and consult on the route of the Erie Canal.[93]

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[87] The equivalent of approximately $148,000 in 2022.

[88] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 31f.

[89] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 11ff; Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 228.

[90] "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 258; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 41.

[91] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 228.

[92] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 11ff.

[93] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 24.

His proudest accomplishment, however, was to secure a source of clean water within Fort McHenry in Baltimore, using technically complex mine shaft-type excavation and sheet piling, during the War of 1812.[94]

Latrobe next hired Frederick Graff as his draftsman.[95] At age 14, Graff (27 Aug 1775–13 Apr 1847)[96] had begun an apprenticeship with the Carpenters Company of John Rugan and Mark Rodes.[97] He might have become a builder, what today we would call a construction contractor, like his father and grandfather, but around age 22 he injured a knee (likely the right) with a hatchet[98] so severely that his leg almost required amputation and he briefly hovered near death. He did recover but walked with a limp for the remainder of his life.

Graff applied himself instead in a less physically demanding direction.[99] His skills had somehow come to Latrobe's attention during his recuperation or shortly after and Latrobe hired him as one of his draftsmen. Graff excelled at it and contributed to Latrobe's landmark Bank of

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94 John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine*, Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 24ff. Previously, due to the geology of the peninsular site, water had to be carted in from three miles away. During the famous bombardment by the British navy in September 1814, the well would supply American soldiers with ample water and prove to be a crucial factor in enabling the Americans, as celebrated in the American national anthem, to defend the fort against the assault.

95 Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 1. See also, for example, Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe*, Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), Drawing C45 at 241 (desc. at 242), Drawing C47 at 242, Drawing C47 at 242, Drawing C53 at 248, Drawing C54 at 248

96 Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 341ff; James F. O'Gorman, et al., *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986*, (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts, 1986), 43f.

97 Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe*, Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 228.

98 Latrobe recalls Graff's knee injury in a letter to William Loughton Smith; *Correspondence of Latrobe*, 1:458–459. Cited in Arthur S. Marks, "Palladianism On the Schuylkill: The Work of Frederick Graff at Fairmount," *Proceedings of the American Philosophical Society*, Vol. 154, No. 2 (Philadelphia: Jun 2010), 208n.21.

99 *Fredk. Graff's Book, 1798,* collection of Winterthur Museum, Wilmington, Delaware.

Pennsylvania project.[100]

From depictions of Graff that were made during his lifetime,[101] we can see that he was not very tall, but he possessed a robust frame. Fresh-faced in his youth, he had deep-set brown eyes, a strong Roman nose, and a small mouth framed by a prominent chin. His head was full of wavy, dark brown hair which he kept into old age, though it is not known the degree to which it greyed as he grew older.

It was while working for Latrobe that Graff grew into a brilliant engineer,[102] specializing in what today would be called architectural and hydraulic civil engineering.[103] Graff impressed Latrobe, who predicted "that this [Graff's] native state will be at some future period, benefitted and honoured by his professional and personal character." The two developed a close working relationship. "I have…the pleasure of considering him as the first of my *élèves,*[104]—and as my friend…," Latrobe wrote in 1804.[105]

Construction commenced on 12 Mar 1799 with work on the tunnel along Chestnut Street.

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[100] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 184, 220, Drawing C19 at 221.

[101] James Peale, *Frederick Graff,* 1804, oil on canvas, 27 9/16" × 23 9/16" (70cm × 59.8cm), Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University, Philadelphia; Moses Williams, *Frederick Graff* (silhouette), 1805, hollow-cut paper on black paper, 4 7/8" × 4" (12.4cm × 10.2cm), Philadelphia Museum of Art, <www.philamuseum.org/collection/object/308040>, accessed 20 Aug 2022; Auguste Edouart, *Frederick Graff and Solomon White Roberts* (silhouette), 14 Apr 1843 and 7 Oct 1842, ink wash, pencil, and cut paper on paper, 11 1/8" × 8 3/8" (28.2cm × 21.2cm), National Portrait Gallery, Smithsonian Institution, Washington D.C., <https://npg.si.edu/object/npg_S_NPG.91.126.117.B>, accessed 20 Aug 2022; Hugh Cannon, *Frederick Graff,* 1847, Italian marble bust, Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University, Philadelphia.

[102] Engineers were called "mechanics" or "mechanicians" at the time.

[103] Graff's injury to his leg likely had an enormous affect on his career. The temporary immobilization imposed by his convalescence would have provided the opportunity to study and practice engineering and drafting, enabling him to transition from a career as a general construction contractor to that of an engineer.

[104] French for "pupils." Pronounced "ay-LEV."

[105] Latrobe to William Loughton Smith, 21 Mar 1804, Latrobe Letter books; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 41, and Arthur S. Marks, "Palladianism On the Schuylkill: The Work of Frederick Graff at Fairmount," *Proceedings of the American Philosophical Society,* Vol. 154, No. 2 (Philadelphia: Jun 2010), 210n.29.

Much of it had to be dug through bedrock and progress was slower than expected. Poor weather further delayed the work. As yellow fever returned during the summer and autumn of 1799, construction slowed to a crawl. Latrobe himself fled the city but traveled back every day to supervise the work.[106]

Perhaps the trickiest portion of all was the advanced technology, in the form of the steam engines. Casting about for a source of engines, Latrobe investigated and found Nicholas Jacobus (James) Roosevelt. Son of a New York City shopkeeper, Roosevelt (1767–1854)[107] had shown an early technical aptitude and at age 26 had become the director and manager of a mining company that was attempting to reactivate the abandoned Schuyler copper mine near the Passaic River in northern New Jersey.[108]

In order to pump out water which collected in the mine, the company utilized a type of steam engine known as a Newcomen-type, low-pressure, atmospheric engine, imported from Britain. The steam engine had been operating there since 1753, long before Roosevelt had purchased the mine.[109] Steam engines had been used for this purpose in Europe for decades prior to that,[110] but this was the first used in America. After observing the operation of the engine, the

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[106] Latrobe, Journal, XVI, 36 (17 Sep 1799), cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 34. Graff and Latrobe maintained a close relationship, regularly exchanging correspondence, until the latter's untimely death in 1820. See Arthur S. Marks, "Palladianism On the Schuylkill: The Work of Frederick Graff at Fairmount," *Proceedings of the American Philosophical Society*, Vol. 154, No. 2 (Philadelphia: Jun 2010), 210n.30.
[107] Nicholoas J. Roosevelt was the great-great-grandson of Dutch immigrant Claes Maartenszen Van Rosenvelt, the Dutch immigrant who established the Roosevelt family in America in the 17th century, and the great-grand uncle of Theodore Roosevelt, Jr., 26th President of the United States. He was a more distant relation of Franklin D. Roosevelt, 32nd President of the United States. See Charles Barney Whittelsey, *The Roosevelt Genealogy, 1649–1902* (Hartford: J. B. Burr & Co., 1902).
[108] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography*, Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 243f.
[109] *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 256.
[110] Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900.* (New York, Oxford University Press, 1967) 246ff.

enterprising Roosevelt soon began manufacturing his own steam engines.[111] Roosevelt had a history of innovative thinking. In 1798 he had come up with the idea of the vertical paddle wheel for steamboat propulsion, eventually used by Robert Fulton in the first commercially successful steamboat. Later Roosevelt would work closely with Fulton to provide steam engines for the latter's pioneering steamboats on the Ohio and Mississippi Rivers.[112]

Latrobe visited Roosevelt and liked what he saw; he proposed that the City contract with Roosevelt to build the two steam engines. On 23 May 1799 Roosevelt signed a contract with the City; for $9,000,[113] he would construct two steam engines similar to the low-pressure, atmospheric engines of Boulton & Watt in Britain and transport them to Philadelphia for use by the first of September of the same year.[114] This timeframe was chosen because that is when another yellow fever season might again be expected.

The relationship between Roosevelt and the City was complex.[115] Through a series of contracts, he was to be paid for constructing and maintaining the two steam engines. For an annual fee, he was also allowed to occupy the Schuylkill Engine House and use for his own purposes all of the excess power from the steam engine not needed at any given time for pumping water. A seeming win-win situation for both parties—Roosevelt could earn income on the side and the city would have extra capacity to meet future water needs—the arrangement

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[111] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 243f.
[112] *The Encyclopedia Americana* (1920); "Nicholas Roosevelt," *New Netherland Institute* (2022), <www.newnetherlandinstitute.org/history-and-heritage/dutch_americans/nicholas-roosevelt>, accessed 19 Sep 2022.
[113] The equivalent of approximately $210,000 in 2022.
[114] Committee Appointed by the Common Council to Enquire into the State of the Water Works, "First Agreement with Mr. Roosevelt [23 May 1799]," *Report* (Philadelphia: William Durant, 1802), 21ff.
[115] For the series of contracts between the two parties and others, see Committee Appointed by the Common Council to Enquire into the State of the Water Works, *Report* (Philadelphia: William Durant, 1802).

would soon prove problematic.[116]

Nevertheless, the decision to use steam engines to power the pumps had been a bold step for the Watering Committee to take. At that time there were only three steam engines in America, all Newcomen-type, low-pressure engines,[117] one each in New Jersey (at the Schuyler mine), Rhode Island, and New York.[118] An essential part of Latrobe's plan was the use of engines of the Boulton & Watt type, also low-pressure but more efficient, which he asserted were "as tame and innocent as a clock."[119] This was more or less true; it wasn't the engine itself but the boiler that typically caused safety problems. The more immediate and pressing concern, however, was the difficulty in achieving the required level of precision in fabrication. No matter how safe the design, without the close fit of well-made parts a steam engine wouldn't work at all.

Although two of Roosevelt's employees, foundryman James Smallman[120] and chief draftsman Charles Stoudinger,[121] were experienced men who had once worked for Boulton & Watt,[122] numerous difficulties in the manufacture of parts for the engines resulted in extensive delays. The 1 Sep 1799 deadline came and went without delivery of the engines.[123]

Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 245ff; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 32, 39f.

[117] For a brief description of the types of early steam engines and their development, see Chapter 3.

[118] Carroll W. Purcell, Jr., *Early Stationary Steam Engines in America: A Study in the Migration of a Technology* (Washington, D.C., Smithsonian Institution Press, 1969), 5-9.

[119] Benjamin H. Latrobe, *An Answer to the Joint Committee of the Select and Common Councils of Philadelphia, on the Subject of a Plan for Supplying the City with Water, &c.* (2 Mar 1799), 7.

[120] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 38.

[121] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 233; Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 38. Stoudinger's name is sometimes spelled "Staudinger" in extant documentation.

[122] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 38.

[123] Benjamin H. Latrobe, *Report on the Progress and State of the Water works on the 24th of November, 1799,* 16, 32; Sharf and Westcott, *History of Philadelphia,* I, 500–501, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 33.

In July of 1800, with the project nearly a year behind schedule, Thomas Pym Cope, a member of the Watering Committee from the Select Council, was sent by the chairman of the committee to investigate the manufacture of the engines in Roosevelt's Soho Works in northern New Jersey, not far from Roosevelt's copper mine. A wealthy merchant and philanthropist, Cope later founded Philadelphia's first packet line[124] and was elected to the Pennsylvania state legislature. He was well-qualified to evaluate Roosevelt's operation.

Cope kept a diary of the visit. His description of the casting and finishing of the "Great Cylinder" for the engine intended for the Schuylkill Engine House provides a glimpse into the complexity and the difficulty of producing a precision product with the tools and techniques of the time:

> The large cylinder for the engine to be used on the banks of the Schuylkill at the water works was cast in two pieces, and united by copper, the joint being secured externally by a strong band of cast-iron, eighteen inches broad, weighing 1,200 pounds. Seven thousand five hundred weight of metal was used for the cylinder; it is six and one- half feet long, and about thirty-eight and one-quarter inches in the bore; about 3 inches throughout was at first to be cut away; one half inch has been accomplished; two men are required, one almost lives in the cylinder, with a hammer in hand to keep things in order, and attend to the steeling (cutters), the other attends the frame on which the cylinder rests, which is moved by suitable machinery; these hands are relieved, and the work goes on day and night; one man is also employed to grind the steeling; the work is stopped at dinner time, but this is thought no disadvantage, as to bore constantly the cylinder would become too much heated; the work also stands whilst the steeling are being changed, which required about ten minutes time, and in ten minutes more work they were dull again; I examined some of them and found them

[124] A fleet of medium-sized ships, called packet boats, offering regularly scheduled transatlantic passenger and freight service.

> worn an eighth of an inch in that time. Three of these steeling (or cutters), about three and one-half inches on the edge, are fixed in the head piece at one time. The head piece is a little less than the diameter of the cylinder, and six inches thick, secured upon a rod of iron eight inches in diameter, which forms the shaft of a water wheel.
>
> The workmen state that the boring was commenced on the ninth of April, and had been going on ever since, three months, and about six weeks more will be required to finish it.
>
> The wrought iron[125] for the flue of the boiler over the fire will be imported from England, and is in sheets 38 by 32 inches. That yet made in this country is clumsy stuff of different sizes, the largest being 26 by 18 inches, with rough edges which have to be cut smooth by the purchaser.[126]

When Cope remarked that the work was to have been completed and in operation by August 1799, Roosevelt answered that both he and Latrobe knew that was not possible but had to agree in order to get the contract. The steam engines were finally completed and most of the parts were shipped to Philadelphia by sea, but the giant cylinders were sent overland, arriving on 29 Oct 1800.[127]

The steam cylinder for the engine in the Schuylkill Engine House was 38½ inches in diameter, had a 6-foot stroke, and drove a double acting pump 17½ inches in diameter, also with a 6-foot stroke. Centre Square's cylinder was 32 inches in diameter and had a 6-foot stroke. It drove a double acting pump 18 inches in diameter. The pumps in both engine houses had a 6-foot

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[125] "Wrought" is an old form of the modern word "worked." Wrought iron is a form of iron that is malleable yet tough and can be worked by hand or machine. Cf. cast iron, which is cast in a mold and is hard, nonmalleable, and brittle. *Webster's Ninth New Collegiate Dictionary* (1985).

[126] "Extract from Report of T. P. Cope," 4 Jul 1800, incl. in Frederic Graff, Jr., *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 2f. Also excerpted in "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 259f.

[127] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 38.

stroke.[128]

The funding of the project was at least as difficult as the construction. The City had to find a way to pay for the new venture. It had attempted to ask the state legislature to assign to it the customs duties from the Philadelphia port, but the Delaware and Schuylkill Canal Company fought it on the grounds that giving public money to the City of Philadelphia so it could build a water works would violate its corporate rights and requested that the state assign the customs duties to the Canal Company instead. The state legislature decided to do neither.

In February 1799, City Council had arranged for a $150,000 loan,[129] financed by issuing $100 bonds,[130] to finance whichever plan was to be chosen. Purchasers would pay for the bonds in installments over six months and then earn annual interest of six percent. As a further inducement, owners of the bonds, or subscribers as they were called, would also receive water free of charge for three years.[131] By the summer, however, the bond issue had still only raised half of the intended amount, and ultimately brought in only $74,100.[132] One reason was that the federal government happened at the same time to begin issuing bonds with an eight percent annual return, making them more attractive than the city's bonds. Opposition from the Canal Company made some potential investors hesitant as well. Still others just didn't think Latrobe's plan would work. Bad weather even slowed promotion of the bonds.[133]

Watering Committee members were at times reduced to contributing funds out of their

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[128] Frederic Graff, Jr., *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 3.
[129] The equivalent of approximately $3.5 million in 2022.
[130] The equivalent of approximately $2,300 in 2022.
[131] *Ordinance Providing for the Raising of a Sum of Money for Supplying the City of Philadelphia with Wholesome Water* (Philadelphia: Zachariah Poulson, Jr., 7 Feb 1799), 3ff.
[132] Committee Appointed by the Common Council to Enquire into the State of the Water Works, "Statement of the Sources," *Report* (Philadelphia: William Durant, 1802), 66. The amount was the equivalent of approximately $1.7 million in 2022.
[133] Mayor and Committee of the Select and Common Councils, *Report* (Philadelphia: Zachariah Poulson, Jr., 24 Nov 1799), 16ff.

own pockets. Thomas Pym Cope recorded in his diary one such incident on 8 Nov 1800 when John Davis, the Clerk of the Works, rushed into his office saying “The men refuse to work until their wages are paid. I have no money, but have prevailed on them to remain until I could see you.” Cope’s response? “I forthwith raked up my small resources, hurried on horseback to the discontented labourers, satisfied their wants & kept them at work. I waited to be reimbursed from these inconvenient advances, on my part, by the tardy collections from taxes.”[134] Cope would do the same thing again eight days later, contributing nearly $2,000[135] in this way.[136] Latrobe himself resorted to contributing income from a modest inheritance.[137]

The financial difficulties were so severe that the project was nearly abandoned. It might have been, were it not for the recognition that workers and expertise would have dispersed, and all the money previously spent on the project would have been lost.[138] The struggle to find funds continued. A special tax was levied in 1799 despite public protest; it generated $49,000.[139] Municipal assets were sold off. The City was also able to obtain two loans from the Bank of the United States, cosigned by several prominent citizens, including Cope,[140] totaling $40,000.[141] A second subscription bond issue in 1801 realized approximately $27,000.[142]

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[134] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 385.
[135] The equivalent of approximately $47,000 in 2022.
[136] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 41, 43.
[137] Latrobe to Rev. William Dbourg, 12 Nov. 1809, Latrobe Letter books in possession of Mrs. F. C. Latrobe II, Baltimore, Maryland, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 34. The inheritance was much smaller than Latrobe had expected.
[138] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 33.
[139] The equivalent of approximately $1.2 million in 2022.
[140] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 385.
[141] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 41, 385. The amount was the equivalent of approximately $940,000 in 2022.
[142] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 33ff. The amount was the equivalent of approximately $630,000 in 2022.

The steam engine in the Schuylkill Engine House was started on 22 Dec 1800.[143] When the engine in the Centre Square Engine House was started on 27 Jan 1801, Mayor John Inskeep and members of City Council conducted a formal opening.[144] Water finally began to flow and the system became operational. *Poulson's American Daily Advertiser* reported:

> A number of country men, who happened to witness this first introduction of the water, gaped with astonishment as at the tenth wonder of the world. They will speedily return home to communicate the marvelous tidings: and it will be well if they are not dubbed liars, when they come to relate what they saw to their credulous neighbors and friends.[145]

Latrobe had estimated the project would cost $127,000[146] and take seven months to complete; in the end it required more than $220,000[147] and 20 months. But it was done.[148] Despite the hardships and uncertainties of construction—or perhaps because of them—the *Advertiser* gushed:

> This is a joyful circumstance to the citizens at large and must be particularly gratifying to those gentlemen of the Corporation who have, through varied and multiplied difficulties,

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143 Frederic Graff, Jr., *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 5.
144 *Poulson's American Daily Advertiser,* 27 Jan 1801, reported on water operations on date of publication. Watering Committee, *1849 Annual Report,* 3 Jan 1850, chart at p. 28 ("Statistics Relating to Fairmount Water Works"), states water supplied beginning 1 Jul 1801. Watering Committee, *1852 Annual Report,* 6 Jan 1853, p. 46, states first water supplied 21 Jan 1801. "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 261, states Schuylkill engine began operating 22 Dec 1800 and Centre Square engine began operating 27 Jan 1801. This jibes with *Poulson's,* as does Frederic Graff, Jr., in *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 5. Annual Report for 1852 has good general description of Schuylkill and Centre Square Works at 22ff. See Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 228; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem In the United States* (Syracuse: Syracuse University Press, 1956), 35f, for good summary descriptions of combined works.
145 *Poulson's American Daily Advertiser,* 27 Jan 1801.
146 The equivalent of a little under $3 million in 2022.
147 The equivalent of nearly $5.2 million in 2022.
148 Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 34.

> persevered to the completion of an object of the first magnitude, both as it respect the health and convenience of the city.[149]

The editor of the *Advertizer* was not engaging in hyperbole; for its day the Water Works, as it was often simply called, was a genuine marvel. Prior to this, Americans had never seen anything like it on this scale.

At its most basic the system consisted of two pumping facilities, connected by a below-grade tunnel and ending in a distribution system. It provided water from the Schuylkill River to the citizens of Philadelphia.

Water entered the system into a marble-lined settling basin, 200 feet long and 84 feet wide, which was carved into the east bank of Schuylkill River at Chestnut Street. The bottom of the basin was three feet below the level of low tide. [150]A tidal gate, like a large flapper valve, allowed water in only during ebb tide when clearer water flowed downstream from above and prevented water from entering during high tide when turbid water swirled upstream from below. The water passed from the large basin to a narrow, 160-foot-long, second basin[151] and into an oval, subterranean tunnel (often called the lower tunnel) which was 300 feet long, six feet wide, and cut through bedrock.

From the lower tunnel, the water flowed into a well 10 feet in diameter. The well rose vertically 54 feet[152] to the Schuylkill Engine House (often called the Lower Engine House) on the north side of Chestnut Street, just west of what was at the time called Schuylkill Front Street

[149] *Poulson's American Daily Advertiser,* 29 Jan 1801, quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 35.
[150] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 9.
[151] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 9.
[152] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 10.

(between today's 22nd and 23rd Streets).[153]

The steam engine within the Schuylkill Engine House pumped the water from the bottom of the well up 39 feet[154] and discharged it into a brick-lined, 6-foot-diameter tunnel. Although this second tunnel was much closer to the surface than the first, and constructed using what we would today call the cut-and-cover method, it was also largely carved out of bedrock. It stretched some seven tenths of a mile eastward beneath Chestnut Street to Broad Street where it turned north for one block to reach the Centre Square Engine House, often called the Upper Engine House.[155] At Centre Square a second steam engine pumped the water from the tunnel up 50 feet to internal reservoir tanks near the top of the building. In hydraulic terms, the height of the reservoir tanks provided a head which created sufficient pressure to ensure the availability of water in even the highest portions of the city's buildings at the time. From the reservoirs, the water flowed by gravity down to a 4×8-foot[156] iron distribution chest[157] located below ground just outside of the east side of the engine house and from there through wood pipes beneath the streets and alleys to residential and commercial water subscribers, hydrants, and public spigots in

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[153] As noted earlier, this is located between today's 22nd and 23rd Streets. See John Hills, *Plan of the City of Philadelphia and its Environs (shewing the improved Parts)* (30 May 1796); *Plan and Profile of Philadelphia's First Water Supply System,* (Philadelphia Water Department, 1905).

Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 231.

[155] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), Fig. C43 at 240.

[156] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 10.

[157] Eleanor A. Maass, "A Public Watchdog: Thomas Pym Cope and the Philadelphia Waterworks," *Proceedings of the American Philosophical Society,* Vol. 125, No. 2 (Philadelphia: Apr 1981), 144. Cope notes the distribution chest was composed of ten pieces of iron and when assembled would contain four hogsheads (256 ale gallons) of water. See also Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), Fig. C43 at 240. For the general configuration of the distribution chest, see inverted pencil sketch at top of the figure.

the settled portion of the city.[158]

The distribution mains were made of wood logs of spruce and yellow pine; they stepped down in size as they progressed from the larger thoroughfares to the smaller streets. In this regard, the street grid which Thomas Holme laid out for William Penn some 120 years earlier[159] proved to be ideal. Two mains, each ten-inch-wide oak logs bored to a 6-inch interior diameter, ran beneath High Street. Arch and Chestnut Streets each received one log pipe with a 4½-inch interior diameter. Log pipes with interior diameters of 4 inches and 3 inches were laid beneath the cross streets.

Each square had a small wooden cistern sunk under the pavement, with a wooden hand pump for public use. These cisterns were kept full by a hollow floating ball that opened or closed a stop cock.[160] In addition to the cisterns and pumps, every block had a hydrant to be used in case of fire, although many residents collected water from these as well.[161] In the evenings, residents would gather at pumps or hydrants to fill their buckets, tubs, watering pots, or what-have-you for the next day's supply.[162]

Although the two engine houses were both designed by Latrobe, they couldn't have been more different. The Schuylkill Engine House was strictly utilitarian, a rectangular building approximately 66 by 54 feet. Its stone walls tapered slightly inward as they rose approximately

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[158] Benjamin H. Latrobe, *An Answer to the Joint Committee of the Select and Common Councils of Philadelphia, on the Subject of a Plan for Supplying the City with Water, &c.* (2 Mar 1799); Mayor and Committee of the Select and Common Councils, *Report* (Philadelphia: Zachariah Poulson, Jr., 24 Nov 1799), 24ff; Water Department, *Chief Engineer's 1875 Annual Report,* (6 Apr 1876), 14ff.
[159] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 7ff.
[160] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 42. This would be similar to the setup in many modern toilet tanks.
[161] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815-1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 6.
[162] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815-1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 15.

30 feet[163] to a hipped, nearly eaveless roof. From each of the two points of the roof rose a short square chimney, one for each of the engine's two boilers.

The Centre Square Engine House, on the other hand, was designed by Latrobe to befit the visual focal point of the city. Evoking a classical Roman motif,[164] the marble-clad facility was in the shape of a cylinder atop a square base. The one-story podium was 60 feet on a side and 25 feet high. Rising 35 feet from the top of the podium was a tower 40 feet in diameter, topped with a shallow dome penetrated at its center by a short chimney. The east and west fronts each featured a portico with two Greek Doric columns. Carved of single blocks of marble, Latrobe later described them as "the largest single Column blocks got out [quarried] in America."[165] Some Philadelphians affectionately called the building the "Pepper Box" because of its shape and possibly partly because the black smoke that issued from the chimney tended to deposit soot on the marble exterior.[166]

The rotunda within the tower featured a clear span of 35 feet and housed the steam engine with its two boilers and their flues, a double-acting pump, the water reservoir above, a pipe shaft for water being pumped up to the reservoir tanks, a pipe shaft for water being carried by gravity from the reservoir tanks down to the distribution chest, and various support structures and stairs

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[163] Dimensions derived from Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), Figs. C24 at 232, C27 at 233, C35 at 233, C36 at 235, C39 at 236, and C41 at 236.

[164] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 228.

[165] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 230.

[166] John F. Watson, *Annals of Philadelphia, and Pennsylvania, in the Olden Time,* Vol. II (Philadelphia: Edwin S. Stuart, 1887), 457.

leading to and around the machinery. Available documentation suggests that a marble reservoir tank with a capacity of 22,500 gallons was initially constructed, in accordance with Latrobe's original design, but that in 1806 the marble reservoir was replaced, possibly due to leakage, by two wood reservoirs with a combined capacity of 17,660 gallons.[167] Outside of the rotunda space, the podium contained various spaces and offices for the Watering Committee, Chief Engineer, and Superintendent, as well as a workshop and coal cellar.[168]

With the completion of the Water Works, Centre Square was developed into a park-like setting. As the Upper Engine House was designed by Latrobe to harmonize beauty with utility, the "new" Centre Square around it was designed to harmonize the natural with the artificial, a recurring theme in early nineteenth century culture. Poplar trees were planted, pathways were laid out, and lawns were seeded. In 1809 the Watering Committee commissioned a fountain for the grounds from fellow member and pre-eminent sculptor William Rush (1756–1833).[169]

Rush is often identified today as America's first significant sculptor.[170] After fighting in

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[167] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 239, 244, Fig. C42 at 238, Fig. C50 at 243, Fig. C51 at 244; *Report of the Watering Committee to the Select & Common Councils* (13 Nov 1806), 3; Committee Appointed by the Common Council to Enquire into the State of the Water Works, *Report* (5 Dec 1801), 48; Watering Committee, *1807 Annual Report* (13 Nov 1807), 3; Watering Committee, *1852 Annual Report*, 6 Jan 1853, 24.

[168] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 237ff, 242ff.

[169] Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937); Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone,* Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974); and Linda Bantel, ed., *William Rush, American Sculptor* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982).

[170] Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937), 7; Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone,* Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 8ff.

the War for Independence,[171] he had begun his career as a carver of ship's figureheads, attracting numerous commissions for the United States Navy as well as private shipping lines,[172] eventually becoming recognized as one of the worldwide leaders in the art form.[173] In 1805 he helped found the Pennsylvania Academy of the Fine Arts and was long a director.[174] Three years later he provided two larger-than-life figures for the exterior of a Philadelphia theatre designed by Benjamin Latrobe.[175] In 1824 Rush would create two large figures for a grand triumphal arch created to welcome the Marquis de Lafayette, one of the heroes of the War for Independence, on his celebrated return to Philadelphia.[176] Rush's full-length statues and portrait busts in both wood and terra cotta, many of which survive, were highly sought after.[177] Late in life, he and his oldest son would create numerous sculptures for the grounds of the Fairmount Water Works.[178] Active

[171] *Pennsylvania Archives,* Vol. XIII (1890), 675; cited in Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937), 11, 11n2.
[172] Linda Bantel, "William Rush, Esq.," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 10ff.
[173] Linda Bantel, "William Rush, Esq.," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 15f. See also John F. Watson, *Annals of Philadelphia and Pennsylvania, in the Olden Time* (1830, rev. 1905); cited in Linda Bantel, ed., *William Rush, American Sculptor* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 15, 193n21.
[174] *Minutes of the Board of Directors of the Pennsylvania Academy of the Fine Arts, 1805–1834*, Pennsylvania Academy Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 17, 193n33.
[175] D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 31ff, Plate III at 33; Linda Bantel et al., "Catalogue," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 108ff. Latrobe was the leading promoter of sculpture in America during his lifetime. See D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 35.
[176] Linda Bantel, "William Rush, Esq.," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 19; D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 37ff; Linda Bantel et al., "Catalogue," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 139ff.
[177] Linda Bantel, "William Rush, Esq.," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 25ff; Frank H. Goodyear, Jr., "'Tolerable Likenesses': The Portrait Busts of William Rush," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 47ff.
[178] Linda Bantel, "William Rush, Esq.," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 23f; Linda Bantel et al., "Catalogue," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 172ff, 174.

in civic affairs, Rush was elected to the Common Council in 1801 and served until 1826.[179] During his tenure he was one of the more active members of the Watering Committee.

Although in his fifties at this time, Rush was hitting his stride as an artist.[180] For Centre Square he created and installed the landmark *Allegory of the Schuylkill River*,[181] the "first figural fountain in America."[182] Carved of wood and painted white, the sculpture was a life-sized figure of a woman standing atop a mound of native stone. She held on her right shoulder an American bittern, a member of the heron family which was common along the Schuylkill River at the time. From the bird's bill a jet of water issued eight feet into the air before cascading down upon the sculpture. From lead pipes streams of water rose from among the rocks to shower the figure from below. Rush himself selected the stone and personally supervised the installation of the sculpture

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[179] *Minutes of Select and Common Councils, 1801–1826,* R.S. 120.2, 120.3, City of Philadelphia Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 17, 193n32.

[180] D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 31.

[181] Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937), 20, 26ff; D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed. (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 35ff; and Linda Bantel et al., "Catalogue," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 114ff. Unlike Rush's bills for other sculptures commissioned by the Watering Committee, his invoice for this fountain did not provide his intended symbolism. It has at various times been called *Nymph and the Swan, Leda and the Swan,* and *Water Nymph at Fairmount.* Marceau popularized *Water Nymph and Bittern.* Bantel and Thompson make a compelling case, however, for *Allegory of the Schuylkill River* as its proper name.

[182] D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 35. See also Talbot F. Hamlin, Benjamin Henry Latrobe (New York, 1955), 159, 156; cited in Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone,* Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 8, 344n1. Sellers identifies the work as "America's first decorative fountain built with public funds."

and fountain[183] in front of the east entrance to the square in 1809.[184]

Rush's fountain made quite an impression.[185] Without betraying modesty, the sculpted form nonetheless simulated the effect of a wet and clinging drape around the female figure. It elicited admiring reviews citing its gracefulness and charm. Even thirty years later, ten years after the fountain was moved to the Fairmount Water Works, a resident would remark in a letter to a local publication:

> I recollect well when she made her first appearance in the centre square, in the midst of a *jet d'eau* and play of fountains, her form delicate and chaste, and her dress closely begirting her, and appearing to adhere to her from the visible effects of the shower.[186]

It is said that Rush used 27-year-old Louisa Vanuxem, the attractive socialite and daughter of Watering Committee Chairman James Vanuxem, a shipping merchant and chairman of the Watering Committee at the time, as the model for the sculpture.[187] Almost certainly apocryphal is the legend that Louisa modeled in the nude for the full figure.[188]

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183 *Watering Committee Papers* (1809), City of Philadelphia Archives; quoted in Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone,* Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 9, 344n7. The invoice reads, "The Corporation City Philada.//Dr. Wm. Rush//to carving figure for fountain at Centre Square//to collecting stone for Ditto and//Superintending the Erection thereof//and painting figure $200."

184 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9f. See also Henri Marceau, *William Rush, 1756–1833: The First Native American Sculptor* (Philadelphia: The Pennsylvania Museum of Art, 1937), 26ff.

185 Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937), 28f. See also *Poulson's American Daily Advertiser* (28 Aug 1809); quoted in Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone,* Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 10.

186 "Fairmount and Croton Water Works" (letter to the editor), *The North American,* Issue 203 (Philadelphia, Pennsylvania: Monday, 18 Nov 1839); Issue 203.

187 "Mrs. Louisa Vanuxem Smith [obituary]," *Boston Globe* (6 Mar 1874), 4; John W. Jordan, ed., *Colonial and Revolutionary Families of Pennsylvania,* Vol. III (1911, reprinted 1978, 1994), 1688; D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 36; William H. Gerdts, "William Rush: Sculptural Genius of Inspired Artisan?," *William Rush, American Sculptor*, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 72f; Linda Bantel et al., "Catalogue," *William Rush, American Sculptor,* Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 116.

188 Thomas Eakins (1844–1916), *William Rush Carving His Allegorical Figure of the Schuylkill River,* 1877, oil on canvas, 20⅛×26½ in. (51.1×67.3 cm), Philadelphia Museum of Art; Akela Reason, *Thomas Eakins and the Uses of*

The Centre Square Engine House was an immediate source of civic pride.[189] With its monumental appearance, mysterious sounds emanating from within, and smoke belching from its crown, it became a popular attraction for residents and visitors alike. It was often the scene of gatherings for civic events and celebrations like Independence Day festivities.

The Schuylkill and Centre Square Works was completed behind schedule and over budget, there would be serious problems with its operation, and income would never cover expenses, but it was a start. Philadelphia was beginning to provide clean water for its residents and plenty of it, at least initially. It was bucking a trend as well. Nearly all water supply systems created around this time—in Manhattan, Boston, and Baltimore, for example—were established by private companies.[190] Philadelphia was rare in creating a municipally owned and operated system, one in which water was distributed more equitably and at a lower cost to recipients than anywhere else.[191] An important precedent was set in America regarding the services municipalities were expected to provide for their citizens.

In his diary, Thomas Pym Cope recalled serving on the Watering Committee during this eventful time:

> Various projects were suggested, but the most approved was to raise it [the water] by

History (Philadelphia: University of Pennsylvania Press, 2010), 33ff. The story of Louisa Vanuxem (1782–1874) posing for Rush had been passed down through the Vanuxem family, but in the 1870s Thomas Eakins added the part about her posing nude. He created a series of drawings and paintings of the supposed event, probably as a way to justify his practice and advocacy of painting from nude models, highly controversial at the time. If Vanuxem had posed nude in 1809, the resulting scandal would have ruined not only her own reputation but her father's as well, not to mention that of Rush. Apparently, however, Louisa never engaged in behavior that damaged her reputation, because sometime after posing for *Allegory*, she married a man named Nathan Smith and the two eventually settled in Dunmore, a town outside of Scranton, Pennsylvania. See John W. Jordan, ed., *Colonial and Revolutionary Families of Pennsylvania*, Vol. III (1911, reprinted 1978, 1994), 1688. Conveniently, Eakins began spreading the legend shortly after Louisa's death at the age of 92, when she could no longer refute the tale.

[189] Foreshadowing the public attitude that would later attach to the works at Fairmount.

[190] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 63ff.

[191] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 77.

machinery onto Morris Hill, now Fairmount & thence to distribute it over the City. … As we could not avail ourselves of Morris Hill, we resorted to the only feasible alternative, the adoption of Latrobe's plan. This was not hastily done, much time & thought were spent before we came to this conclusion. The citizens had however become clamourous [*sic*] & we were incessantly urged to action. Many had persuaded themselves that the immediate introduction of a copious supply of pure water could alone save the City from the scourge of yellow fever from which they had suffered so much & from the effects of which the City had not recovered. 'While you are deliberating, said they, the City may be ruined.' Not one of us had any experience. The subject was new not only to ourselves but to all. No City in the United States & few over in Europe could furnish us with a model. If they could, we had no time to go in search of it. The power of steam was just beginning to develop itself in England. Here it had no location & was treated as an *ignis fatuus.*[192] No sooner did we call for money to carry on the work, than these same clamourers [sic] turned round upon us in hostile attitude. We offered proposals for a loan; few subscribed. We resorted to taxation & they refused to pay the taxes & seizures of furniture, horses & carriages ensued as a necessary consequence. While thus beset on the one hand with complaints, opposition & vituperation, we were mortified, vexed & embarrassed by the assumptions, extravagance & lack of skill, too manifest, on the other, of our crafty Engineer [Nicholas Roosevelt]. But amid all, the work went on as some of us were determined it should—if perseverance & a steady eye to the end in view could avail anything. As to myself, I had come to the conclusion that if this attempt to supply Philada. with water failed, I should be compelled to leave the City, greatly as I was attached to it by interest & affection & settle elsewhere. I saw no alternative. Several of my friends declined all intercourse with me & many shunned me in the streets, crossing or

[192] Something unattainable; an illusion or mirage. From the Latin for "foolish fire."

dodging to avoid speaking with me.[193]

[193] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 384f.

CHAPTER 2

A BETTER SOLUTION: STEAM ENGINES AT FAIRMOUNT

As remarkable an advance as the Schuylkill and Centre Square Water Works was for its time, its deficiencies quickly became apparent.

The Centre Square Engine House, especially, appeared to be the very model of classical architecture, serenely containing within and out of sight its dirty and dangerous mechanical apparatus. It was seemingly as beautiful as it was practical, as inspiring as it was useful. On the outside, the Centre Square Engine House was indeed appealing. On the inside, however, it was a cramped nightmare, with the jumble of machinery and equipment forced into an inadequate space where it was difficult and dangerous to move around and hard to make repairs. As we saw in the previous chapter, crammed into the circular area under the dome was the steam engine, a flywheel, two boilers with their flues, a pipe shaft for water leading up to the reservoir tanks, a pipe shaft for water leading down and out to the distribution chest, and numerous support structures and stairs. So tight was the space that the flywheel could only operate by fitting into a slot cut through the interior circular wall. Within the surrounding square podium, none of the offices or workspaces provided sufficient space for their respective functions.[1]

The works was labor-intensive and expensive to operate and maintain.[2] The steam engines in both engine houses, low-pressure engines of the Boulton and Watt type, consumed prodigious amounts of fuel. The Centre Square engine consumed 55 bushels of bituminous coal

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[1] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 237ff, 242ff.
[2] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 38.

from Virginia per day, the Schuylkill engine 70.[3] It was not known at that time how to burn anthracite coal from the coal fields of eastern and northeastern Pennsylvania. Indeed, after unsuccessful attempts to ignite anthracite following an 1806 delivery to the Centre Square Engine House, it was treated like gravel and used to pave a walkway there.[4]

The system's income never came close to covering its expenses. By 1809, the engine at the Schuylkill Works cost $6,254.36 per year[5] to operate and one at the Centre Square Works $7,552.87 per year,[6] totaling $13,807.23 annually.[7] By 1814, the annual costs had risen to $11,900.07[8] for the Schuylkill Works engine and $13,740.18[9] for the Centre Square Works engine, totaling $25,640.25 per year.[10] Water rents, the fees which residents and businesses paid to have water piped into their homes and establishments, failed to cover expenses. As early as 1804, the operation was already nearly $4,000[11] in the hole and the red ink continued to flow. An historian writing for the Water Department in 1876 toted up the cost and expenses of operating the Schuylkill and Centre Square Water Works during its lifetime from 1799 to 1815 as $657,398.91,[12] with income from water rents during the same period $105,351.18.[13] This represented a deficit of $552,047.73.[14] Over its operating lifetime, income from water rents

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[3] "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 261.
[4] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 89.
[5] The equivalent of approximately $150,600 in 2022.
[6] The equivalent of approximately $181,800 in 2022.
[7] The equivalent of approximately $332,400 in 2022.
[8] The equivalent of approximately $200,200 in 2022.
[9] The equivalent of approximately $231,200 in 2022.
[10] Watering Committee, *1806 Annual Report* (13 Nov 1806), 3ff; Watering Committee, *1810 Annual Report* (5 Nov 1810), 2; Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"). The amount was the equivalent of approximately $431,400 in 2022.
[11] Watering Committee, *1806 Annual Report* (13 Nov 1806), 3ff; Watering Committee, *1810 Annual Report* (5 Nov 1810), 5. The amount was the equivalent of approximately $100,300 in 2022.
[12] The equivalent of approximately $12.6 million in 2022.
[13] Water Department, *Chief Engineer's 1875 Annual Report* (7 Oct 1875), 18. The amount was the equivalent of approximately $2 million in 2022.
[14] The equivalent of approximately $10.6 million in 2022. The urge to describe the operation as "under water" is mightily (but, alas, unsuccessfully) resisted.

covered only 16 percent of operating expenses. Needless to say, the income never touched the $220,000 construction cost.[15]

Although some parts of the steam engines were made of metal—the steam cylinders, for example—most of the machinery consisted of wood components. The lever beams, the arms and shafts of the fly wheels, the hot wells,[16] the hot and cold water pumps, the cold water cisterns, and the supports and bracing for everything were all made of wood. Before they were replaced, even the boilers were composed mostly of wood.[17] The great enemy of wood is moisture and there is no shortage of it in a water pumping station. Over time, leaks and the continual humidity within the buildings led to the rapid deterioration of the wood, making frequent replacements and repairs necessary.[18] Ironically, the detrimental effect of a damp environment on wood had been one of Latrobe's arguments against using waterpower.[19]

The use of wood caused other problems as well. The first boilers were 14-foot-long rectangular wood boxes, made of white pine planks five inches thick, braced with oak, and bolted together with iron rods.[20] Inside the large wood box was a cast iron firebox and cast iron flue.[21] Fuel was burned inside the firebox and combustion gases exhausted through the flue and out to a chimney. The heat from the firebox and flues boiled the water in the surrounding wood

[15] The equivalent of approximately $5.2 million in 2022.
[16] The collection tanks for condensed water.
[17] Frederic Graff, Jr., *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 3ff.
[18] See "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 265, for examples including the large lever beam for the Centre Square engine.
[19] Benjamin H. Latrobe, *View of the Practicability and Means of Supplying the city of Philadelphia with Wholesome Water in a Letter to John Miller, Esquire, December 29th, 1798* (Philadelphia: Zachariah Poulson, Jr., 1799) 15; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 26.
[20] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 263.
[21] Frederic Graff, Jr., *Notes of Steam Engines in the United States About the Year 1801, and a Description of Those in Use at the Water Works of the City of Philadelphia* (Philadelphia: 8 Jun 1876), 3f.

box to make the steam necessary to drive the associated steam engine.

The wood in the surrounding box, which contained the water and steam, softened above the water line where it was exposed to the steam. This allowed the steam to leak through the wood joints and bolt holes.[22] Moreover, the different rates of expansion and contraction between the wood and iron parts played havoc, causing additional steam leakage, wearing, and subsequent breakdowns.[23] It was often difficult to generate enough steam to properly operate the engines.[24] Wrought iron fireboxes were tried, then wrought iron flues.[25] The wood boiler for the Centre Square engine was finally replaced by one made entirely of cast iron in December 1801. The one for the Schuylkill engine was replaced with cast iron in March 1803.[26]

The metal components presented their own difficulties. Iron castings often required extensive—and expensive—finishing work. The metallurgical techniques necessary to create large iron plates, whether cast or wrought iron, had not yet been developed. The iron boiler installed at the Schuylkill Engine House in 1801, for example, was bolted together from 70 cast iron plates.[27] Though it represented an improvement over the wood, with repeated thermal expansion and contraction cycles, every seam was a potential source of steam leakage. Added to this was the issue of metal fatigue, little understood at the time, which contributed further to the failure of parts.

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[22] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 263.
[23] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 260f.
[24] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography*, Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 248.
[25] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 261.
[26] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 264.
[27] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 265.

In the Centre Square Engine House the two overhead reservoir tanks and flues for the boilers blocked much of the natural light, making the work—in an age of oil lamps—difficult even during daylight hours. Indeed, a third wood tank was either removed after it was installed or never built at all because of concerns about needed light.[28]

Both steam engines—but especially the Centre Square engine—needed constant attention, a seeming never-ending headache. Just six days after his marriage in February of 1807,[29] 31-year-old Frederick Graff, by then responsible for the successful operation of the entire works, found himself writing to his new bride, Judith (née Sweyer), to apologize for not spending as much time with her as he would like.

> Owing to my attention being particularly required to the Works I am prevented from having that pleasure which to me is the greatest on earth. I flattered myself I should undoubtedly have visited you this evening. But hard fate decreed otherwise, for before I was out of my be this morning, after a poor night's rest I was called to the engine which unfortunately gave way, this with my attention called for elsewhere will to My Generous and Beloved Wife be a sufficient apology I hope for not visiting her. If you know the anxiety of my Mind and my disturbed peace when absent from you who I so much adore. I am well assured you would not attribute my not coming to design, for believe me I am not happy only when In the presence of My Judith. Tomorrow Evening makes me happy I shall embrace my beloved again.[30]

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[28] Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 244; Watering Committee, *1807 Annual Report* (13 Nov 1806), 3; and Watering Committee, *1852 Annual Report* (6 Jan 1853), 24. At first, one storage tank was installed. Three storage tanks were initially planned to replace it, but space and light inside the Centre Square engine house were so limited that only two were subsequently installed, in 1808.

[29] Marriage certificate, 19 Feb 1807, Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.

[30] Frederick Graff to Judith Graff, 25 Feb 1807, Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.

Nine days later, Graff would again write,

> After a pleasant ride this morning I arrived safe home, where I had not been long before I received marching orders to attend my old plague the Engine. This old torment together with that of not having it in my power of visiting you again before tomorrow morning perplexes my old head confoundedly, however even absence from you my thoughts are pleasant.[31]

In July 1808, seven and a half years after the water works began operating, Graff could still write to his wife apologizing for spending two days straight at the water works.

> Time has not for years hung so heavy upon me as the 2 days past. It appears exactly to me as if I had not seen you for weeks. I hope when I one more get you I shall not loose [*sic*] you again for a long, long time. As I find I cannot eat nor sleep with half that pleasure I do when my Dear little Girl is in my arms. I had flattered myself for 2 days past to have been able to visit you this afternoon but alas I am disappointed. The Committee have ordered my attention at the Square [the Centre Square Engine House] this afternoon at 4 o'clock on business of importance, so I am of course debarred from the pleasure I had contemplated of seeing you this afternoon…[32]

Judith certainly couldn't say she didn't know what she was getting herself into; Graff had written her a similar apology under comparable circumstances while they were still courting.[33] Judith's lifelong patience for her husband's frequent and prolonged absences, incidentally, is a profound testimony to Graff's character. Surviving letters to her over the years show him to have been a tender and devoted husband, and a loving father to his children.[34]

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[31] Frederick Graff to Judith Graff, 6 Mar 1807. Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.
[32] Frederick Graff to Judith Graff, 9 Jul 1807. Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.
[33] Frederick Graff to Judith Sweyer [Graff], 25 Oct 1806. Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.
[34] Frederick Graff to Judith Graff, 10 Mar, 1807, 3 Aug 1807, 23 Aug 1817, 26 Jul 1819, 9 Jun 1824, 3 Jul 1824, 6 Jul 1824, 8 Jul 1826, 30 Jan 1829, 1 Feb 1829, 3 Feb 1819, 4 Feb 1829; Frederick Graff to daughters, 5 Aug 1843. Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.

The reason every breakdown was urgent, the reason Graff was so often found in the pump well of one of the engines directing repairs, the reason many repairs could only be made at night[35] was due to one factor. Indeed, it was the single greatest operational problem of the entire system. The two steam engines were arranged in series. In order for the system to work, both engines needed to be operating. If one engine was being repaired, the entire system was shut down.[36]

Heightening the urgency, the wood reservoir tanks in the Centre Square Engine House contained less than an hour's supply of water.[37] This was somewhat alleviated when the tunnel under Chestnut Street leading to Centre Square was full and could serve as a *de facto* secondary reservoir, but if the Centre Square engine was the one which was idled, the water in the tunnel did no one any good. Even when both engines were operating effectively, the limited reservoir capacity meant that the system at times could barely keep up with the demand of a growing city. This was a problem especially when the constant threat of fire was considered. It must have caused Graff considerable anxiety.

Every aspect of the system seemed to present its own share of troubles. For example, the arrangement with Nicholas J. Roosevelt, which seemed like such a good idea at first, became a great source of consternation. The City agreed to pay Roosevelt a total of $9,000[38] for construction and installation of both steam engines. The City also agreed to pay Roosevelt

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[35] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 432.
[36] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 38f.
[37] Morris A. Pierce, "Report of Messrs. Davis and Graff to the Watering Committee of Philadelphia, 18 Dec 1811" *Documentary History of American Water Works* (Department of History, University of Rochester, updated 12 Jul 2018), <http://www.waterworkshistory.us/PA/Philadelphia/1811Report.htm>, accessed 12 Jul 2018; Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859) 431ff.
[38] The equivalent of approximately $211,500 in 2022.

$3,000 per year[39] for each engine that raised to 50 feet one million gallons of water per day, plus additional payments for raising more, up to a total of $6,000 per year[40] ($3,000 for each of the two steam engines) for raising three million gallons per day.[41] In other words, while the City contracted with Benjamin Latrobe to design and construct the overall water works system, it contracted directly with Roosevelt to construct and install the steam engines, then operate and maintain them and provide the city with water.

Taking future requirements into account, the Watering Committee had contracted for a steam engine at the Schuylkill Engine House larger than initially necessary.[42] Until full capacity was needed, the City made a further agreement with Roosevelt which allowed him to use the excess power generated by the engine in the Schuylkill Engine House for his own purposes. Any profit Roosevelt realized from the use of the surplus would be deducted from the payments he received from the City. To facilitate the opportunity, the City even signed a 42-year lease with Roosevelt on land next to the engine house.[43] The arrangement had the potential to save the City a considerable amount and benefit Roosevelt at the same time.

In order to take advantage of the deal, the enterprising Roosevelt entered into a partnership with Benjamin Latrobe and two brothers, Eric and Lewis Bollmann, for the operation of a rolling and slitting mill for the production of iron rods and nails, powered by the extra power

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[39] The equivalent of approximately $70,500 in 2022.
[40] The equivalent of approximately $141,000 in 2022.
[41] Committee Appointed by the Common Council to Enquire into the State of the Water Works, *Report* (5 Dec 1801), 22, 24f.
[42] Benjamin H. Latrobe, quoted in "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 265.
[43] Committee Appointed by the Common Council to Enquire into the State of the Water Works, *Report* (5 Dec 1801), 30ff; Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 245f.

from the steam engine in the Schuylkill Engine House.[44] Justus Erich Bollmann[45] (1769–1821) was originally a physician[46] in the Hanover region of what is today Germany. After an eventful early life,[47] he immigrated to America in 1796 and partnered in business with his brother Lewis a year later.

A commercial acquaintance of Roosevelt's since his arrival, Bollmann was brought in to operate the mill, with his brother, as a physical extension of the Schuylkill Engine House on land Roosevelt rented from the City of Philadelphia under the 42-year lease. This pioneering arrangement represented the first use of a dual-purpose steam engine in America. It was also the first time in America that a rolling and slitting mill had been operated by steam instead of the usual water power. Indeed, it was one of the first industrial plants of any type to be powered by steam in the country.[48]

Unfortunately, the mill was not nearly as successful as it was groundbreaking. From the start, the steam engine underperformed. The steam cylinder was not bored precisely enough to permit efficient operation. Even if it had been, it was difficult to produce sufficient steam with the wood boilers. This meant that the surplus power which the partners had counted upon was

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[44] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 246. Published in the Redlich article are numerous letters from Eric Bollmann to Nicholas J. Roosevelt.

[45] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 243; *Appletons' Cyclopædia of American Biography,* 1900 edition, <https://en.wikisource.org/wiki/Appletons%27_Cyclop%C3%A6dia_of_American_Biography/Bollman,_Eric>, accessed 29 Jun 2018. While Appletons' is notorious for including biographies of fictitious individuals, Bollmann really did exist.

[46] See Justus Ericus Bollman, *Dissertatio Inauguralis Medica de Irritabilitate vis Nervosae Tantum Modificatione* (Goettingae: 13 Apr 1791).

[47] In 1794, for example, Bollmann led an unsuccessful attempt to free the Marquis de Lafayette from a prison in Olmütz (now Olomouc, in the Moravia region of Czechia or the Czech Republic) where the French general was being held by the Austrians.

[48] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 246f.

not consistently realized.[49]

The business aspect of the partnership was even more dysfunctional. The division of capital investment among the three partners was complex. Each was to contribute $10,000.[50] In fact, the Bollmann brothers ended up investing most of the $30,000 themselves,[51] with Latrobe and Roosevelt contributing the steam engine and Roosevelt the mill machinery.[52] There were disagreements over the book value of each of the capital contributions, disputes over the replacement costs of the cylinder and boilers and who should cover them, and arguments over operating expenses like the cost of fuel. Vague accounting methods didn't help the situation. Corporate obligations that should've been counted as liabilities weren't and individual obligations that shouldn't have been counted as liabilities were.[53] For the Bollmann brothers the difficulties could not be overcome; their portion of the partnership went bankrupt in 1802 and was sold at public auction.[54]

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[49] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 248.

[50] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 247. The amount was the equivalent of approximately $235,000 in 2022.

[51] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 248. The amount was the equivalent of approximately $705,000 in 2022.

[52] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 247f, 247n7. A few years earlier, Roosevelt had constructed a copper rolling and slitting mill under contract with the federal government to provide copper plates for warships. Roosevelt had partially fulfilled the contract when it was cancelled along with the ships at the beginning of a new administration (probably when Jefferson became President in March 1801). It is possible the mill machinery which Roosevelt contributed to the partnership was left over from the terminated federal contract.

[53] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 248.

[54] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 249f. See also "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin

As the mill partnership slid into insolvency, Roosevelt's relationship with the City grew ever more contentious. With his own finances a hopeless mess—at one point the Bollmanns loaned him $5,000[55] to see him through personal difficulties[56]—Roosevelt requested the City pay him the $6,000 per year specified in his contract.[57] The city refused, claiming the steam engines were not performing as promised, certainly not pumping the three million gallons per day required by the contract for payment of the additional amount. If that weren't bad enough, the Watering Committee pointed out, Roosevelt had concentrated so much on the Schuylkill engine that he gave up operating and maintaining the Centre Square engine; the City had taken over that job. The City held that instead of owing Roosevelt more, it was the other way around—it was actually Roosevelt who owed the City. Rebuffed, Roosevelt next claimed that although the City had paid him the contracted $30,000 for the steam engines,[58] their construction and installation had actually cost him $77,000,[59] so he was owed an additional $47,000.[60] This claim was as well-received as the previous.[61]

In a letter to Roosevelt in August 1804, Latrobe suggested he shut down the water supply to get the City's attention.[62] By March of 1805, Roosevelt had threatened to do just that.[63] When

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Institute, 1876), 264. The following year the wood boiler in the Schuylkill Engine House was replaced with one of cast iron. The performance of the steam engine was improved enough that it did produce the expected surplus power, but it was too late for the Bollmanns. As Redlich observed, "Once more pioneering had failed to pay the pioneer."

[55] The equivalent of approximately $131,000 in 2022.

[56] Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 248.

[57] The equivalent of approximately $157,000 in 2022.

[58] The equivalent of approximately $705,000 in 2022.

[59] The equivalent of approximately $1.8 million in 2022.

[60] The equivalent of approximately $1.1 million in 2022.

[61] *Report of the Joint Committee, to Whom Was Referred the Memorial and Remonstrance of Nicholas J. Roosevelt* (1805), 1ff; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 39f.

[62] Latrobe to Roosevelt, 13 Aug 1804, Latrobe Letter Books; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 39f.

[63] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 180.

in August of 1805 the City offered to buy out Roosevelt's stake in the mill partnership, his excess power rights, his long-term lease of land next to the Schuylkill Engine House, and all other claims for $10,000,[64] Roosevelt not only pushed for a larger sum, but threatened once again to cut off the water.[65]

Events came to a head shortly thereafter. In late September 1805, during a serious fire in town, the steam engine in the Schuylkill Engine House was found to be idle. There wasn't even enough fuel on hand for workers to start it. The water supply failed, shocking the public.[66] A local newspaper suggested Roosevelt had made good on his threat and had chosen a particularly dangerous time to do it.[67] It's unknown whether this was Roosevelt's intention or merely the usual state of things, but the City had had enough. A few days later the county sheriff, carrying a writ of attachment, showed up at the Schuylkill Engine House.[68] Roosevelt locked himself in the building but the officer broke down the door and threw him out. The sheriff gave possession of the building to the City and the Watering Committee promptly put Frederick Graff in charge of both engine houses.[69] Roosevelt accepted the City's final offer of $15,886[70] for all rights and claims,[71] but after years of deferred maintenance the Watering Committee still had to pony up the cash to pay for expensive repairs to the steam engine and equipment (in addition,

[64] The equivalent of approximately $253,000 in 2022.
[65] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40.
[66] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40.
[67] *Aurora* (24 Sep 1805); cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40.
[68] *United States Gazette*, 27 Sep 1805 and *Aurora*, 28 Sep 1805; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40.
[69] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. I (Philadelphia: L. H. Everts & Co., 1884), 519.
[70] The equivalent of approximately $402,000 in 2022.
[71] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40.

presumably, to one of the building's doors).[72]

Operating and maintaining the steam engines was more than financially hazardous. This was partly because certain dangers were not yet fully understood. A little over two months after the water works became operational in 1801, two men perished at the Schuylkill Engine House in what is today known as a confined-space accident. The engine's boiler, remember, was built of wood with a wrought iron fire box and cast iron flues. On Friday 3 Apr 1801 a smoldering fire was discovered in the boiler's wood components. The workers drained the boiler and closed it up overnight, thinking that would extinguish the fire. The next morning, against the advice of John Davis, the Chief Engineer at the time, laborer John Jacob Brown crawled inside the boiler to work on it. When Brown began to be overcome by gaseous combustion products (carbon monoxide and carbon dioxide, we now know) two other men, Brown's brother and millwright/mechanic Robert M'Coomb, ventured inside to rescue him. Both would-be rescuers were soon in trouble themselves. As Brown's brother struggled back to the entrance at the top of the boiler, he passed out and began to fall back in but was grabbed at the last moment by Davis and another man and pulled to safety. M'Coomb did not fare as well, asphyxiating deep inside the boiler with John Jacob Brown. Because of the thickness of the wood, it took an hour and a half to cut through the side of the boiler to retrieve the two men's remains. Brown was single; M'Coomb left behind a widow and two small children.[73]

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[72] *Report of the Watering Committee, Nov. 13, 1806,* 3, 6; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 40. Despite his rocky relationship with the Watering Committee, Roosevelt must have maintained good relations with Latrobe through this period, because in 1808, at the age of 40, Roosevelt married Latrobe's 17-year-old daughter Lydia. They eventually had four children together, two boys and two girls. See "Nicholas James Roosevelt (1767–1854)," *WikiTree* (5 Oct 2019), <www.wikitree.com/wiki/Roosevelt-337>, accessed 27 Aug 2022.

[73] "A melancholy accident happened on Saturday at the Schuylkill Engine House," *Poulson's American Daily Advertiser* (Philadelphia, Pennsylvania), 6 Apr 1801 (source: <www.GenealogyBank.com>). Thomas P. Cope recorded in his diary that he was the author of the account in Poulson's newspaper. See Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 61.

As fraught with difficulties as it was, the period of operating Philadelphia's first water works had been a time of great innovation. Problems arose that had never before been experienced. Challenges were met, lessons were learned—more often than not the hard way, by trial and error. In an age when there was no formal training for engineers, the design, construction, and operation of the water works provided incalculable on-the-job training. In addition the City itself, through the Watering Committee, gained valuable experience in the funding and managing of a municipal water supply system.[74]

When the water works became operational in 1801, Latrobe had appointed John Davis to replace him as Superintendent[75] before moving to Washington, D.C. to work on the design of the capitol building there.[76] In 1804, the managers of the Baltimore Water Company asked Davis to consult with them on their project for a water distribution system in that city. The board was so pleased with Davis' recommendations that they not only approved them all but offered him the job of Superintendent on the spot. He would oversee the project's construction and manage its operation.[77]

Davis was reluctant to accept the invitation because of his commitment in Philadelphia. After meeting with members of the Watering Committee, however, Davis took the position under one condition—he must have time to select and train his replacement. The Baltimore managers agreed.

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[74] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 41ff.
[75] "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 258; Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 41.
[76] James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 46.
[77] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 11ff.

The man Davis had in mind was Frederick Graff. Despite having proved himself a capable engineer,[78] Graff had doubts about his capability. Davis reassured Graff that he would stay and train him for as long as it took to make him confident that he could run the Schuylkill and Centre Square Water Works. Graff agreed under a trial basis. The Watering Committee gave its approval as well.[79]

Davis and Graff worked side by side from late fall 1804 to early spring 1805, although Graff worked without pay from January through March 1805. When the two were satisfied, Davis departed and Graff was appointed Superintendent of the Water Works on 1 Apr, with an annual salary of $1,200.[80] He was just shy of 30 years old. Nevertheless, Davis would later describe Graff as "one of the most scientifick [*sic*], correct, and practicable Engineers in his line in the United States."[81]

Although an historian writing for the Water Department in 1876 identified a lifetime capital and operational deficit of over a half million dollars for the Schuylkill and Centre Square Works, they nevertheless concluded:

> Yet it cannot be said this sum has been lost to the City, as many indirect advantages have arisen from it, character and impetus was given to the City, much was done to improve the sanitary condition, an important feature which added to its many attractions as a place of residence. Nor was the early experience thus acquired by her mechanics [engineers] a small matter, for perhaps to their pumping engines and the practical knowledge derived from them, may be attributed much of the pre-eminence which this city has always enjoyed in the

[78] Graff had recently been engaged as an engineer, for example, in the construction of the Santee Canal in South Carolina, one of the earliest facilities of its type in the United States.
[79] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 11ff.
[80] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 1. The amount was the equivalent of approximately $30,400 in 2022.
[81] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 18.

construction of machinery….[82]

Frederick Graff designed many solutions himself. For example, in both engine houses, the pumping mechanism suffered from so-called "water hammer," the result of pressure spikes caused by the reciprocating movement of the pump piston.[83] More than merely annoying, it can cause damage to equipment. Water hammer was particularly bad at Centre Square. Whenever the steam engine operated faster than 12 strokes per minute (which it increasingly needed to do as time went by), water hammer threatened to tear apart the pump, engine, mains, and everything to which they were attached. In June 1810, Graff installed on the Centre Square pump a solution of his own design which he called an "air vessel."[84] An oblong, air-filled, cast-iron tank, the air vessel was one type of what is today called a hydraulic accumulator. Reducing pressure spikes by absorbing them, it worked because while water is a liquid fluid and is virtually incompressible, air is a gaseous fluid and is readily compressible. With every spike in hydraulic pressure within the pumps and connecting pipes, the air inside the air vessel would compress and "even out" the change in pressure, protecting the machinery from damage.[85] Graff also created

[82] Water Department, "History of the Water Supply of Philadelphia," *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 18.

[83] Moving water has momentum. Within a closed system, a sudden change in the velocity of the movement (from the closing of a valve or the movement of a pump's piston, for example) can cause a dangerous spike in pressure. This is called *fluid hammer,* or *water hammer* in this case. The reader may perhaps be familiar with a form of this, a thump or bang heard in the plumbing of some homes when a spigot or faucet is quickly closed. Domestic water hammer can cause damage to pipes and fittings, leading to unnecessary repair bills. On an industrial scale, the forces are immense and the damage can be severe.

[84] Watering Committee, *1810 Annual Report* (5 Nov 1810), 1ff; Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 265. In the 1810 Annual Report, Graff described the air vessel: "The air vessel has produced the suspension of the water in the rising main during the action and reaction of the pumping, it steadies the engine and may afford a greater number of strokes by which the reservoirs can be filled in a much shorter time than heretofore."

[85] As one type of hydraulic accumulator, the modern version of the air vessel is still used today. Called a compressed-gas accumulator, it may be found in hydraulic systems as diverse as those in heavy construction equipment, cruise ships, and high-performance jet aircraft. It is often even installed as part of the plumbing in ordinary homes.

and implemented improved designs for fire hydrants beginning in 1803.[86]

For all its trouble and expense, in the end the Schuylkill and Centre Square Works was simply too small. The growth of the city quickly outstripped its ability to provide sufficient water. The longer it operated, the clearer it became that another solution was needed.

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CHAPTER BREAK HERE INSTEAD?

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By 1811 City Councils and their Watering Committee recognized the need for a more effective water supply system. On 24 Oct the two legislative bodies passed a resolution calling for a study. The Watering Committee asked John Davis to return temporarily from his duties in Baltimore and join with Frederick Graff to examine the existing system, evaluate options, and present recommendations.[87] The two looked at previous proposals and reviewed lessons learned from ten years' experience operating of the Schuylkill and Centre Square Works. They were joined in portions of their investigation by Watering Committee member William Rush.[88]

In their report, submitted on 18 Dec 1811, Davis and Graff addressed four groups of

[86] "History of the Steam Engine in America," *Journal of the Franklin Institute,* Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 267.
[87] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine,* Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 11ff.
[88] Watering Committee, *Report of the Watering Committee to the Select and Common Councils* (Philadelphia: 5 Nov 1812), 1f.

questions from the Watering Committee.[89]

First: What is the state of the two steam engines in the Schuylkill and Centre Square Water Works? Is it feasible to bring them up to an acceptable level of operation and if so, what is the one-time and annual cost?

Engineers today would call this the so-called “no-build alternative.” Under this alternative, only minimal necessary improvements are implemented. The no-build alternative provides a baseline against which all other alternatives may be compared and answers the question: How bad will things get if we mostly do nothing?

Significantly, this shows that the Watering Committee, as well as Davis and Graff, were applying a decidedly modern, methodical approach to the problem. They were moving away from improvement by trial-and-error.

Davis and Graff judged this option not feasible. Many of the components of the steam engine in the Centre Square Engine House needed to be replaced just to bring it up to good working order. Some portions of the system would need to be enlarged in order to meet growing demand. The engine in the Schuylkill Engine House was in better shape than the one at Centre Square, but with less than an hour’s reserve capacity, pursuing this course would leave the city without water for a dangerously long period of time. Even so, the two men estimated the cost of repairing the two engines to be $7,330[90] and the annual operating expense to be $18,063.[91]

Second: Is it feasible to install a second steam engine in the Schuylkill Engine House, repair the original engine there, and operate a water distribution system entirely from that

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[89] Morris A. Pierce, “Report of Messrs. Davis and Graff to the Watering Committee of Philadelphia, 18 Dec 1811” *Documentary History of American Water Works* (Department of History, University of Rochester, updated 12 Jul 2018), <http://www.waterworkshistory.us/PA/Philadelphia/1811Report.htm>, accessed 30 Jul 2018.
[90] The equivalent of approximately $165,700 in 2022.
[91] The equivalent of approximately $408,300 in 2022.

facility? How much would this cost?

With this option, the Watering Committee wished to evaluate the possibility of rearranging the existing system to be more effective by adding a second steam engine at the Schuylkill Engine House and distributing water directly to customers from that location. In other words, two steam engines would work in parallel instead of in series and operate in the Schuylkill Engine House. The system would no longer cease to provide water if one of the engines was down for maintenance. This would make it possible to close the Centre Square Engine House where much of the difficulty lay.

Davis and Graff thought this option feasible and estimated the one-time cost to be \$82,444[92] and the annual operating expense to be \$11,886.[93]

Third: What is the best way of constructing a reservoir atop Morris Hill and the best way of supplying it with water? How much would it cost to operate a water distribution system from this location?

This option, unavailable earlier, was now possible because of two events. In 1802 the Delaware and Schuylkill Canal Company's charter, created by the Pennsylvania state legislature in 1792, expired when the company failed to complete its canal within ten years as specified by the terms of the charter. The company had the sole authority to construct a canal along the east shore of the Schuylkill River upstream of Philadelphia, continue the canal from the Schuylkill River to the Delaware River along the northern boundary of the City, and draw water from the Schuylkill River to fill the canal. The authority granted by the state legislature, which had restricted any use of the river by others, included the area of Morris Hill on the east side of the

[92] The equivalent of approximately \$1.8 million in 2022.
[93] The equivalent of approximately \$268,700 in 2022.

river just north of the City.[94] In April 1811, the state legislature chartered the Union Canal Company, folding up into the new company the expired charter of the Delaware and Schuylkill Canal Company and the existing charter of the struggling Schuylkill and Susquehanna Canal Company. The legislation gave the new company all of the authority, rights, and responsibilities of the two old companies, including the sole right to construct a canal along the Schuylkill River, but with one difference. The new company could build the canal on either side of the river.[95] This was significant because it gave the City of Philadelphia an opportunity to draw water from the east side of the river while the canal company could build a canal on the west side.

This new option would allow the City to construct a reservoir atop Morris Hill where there was plenty of acreage for an initial storage capacity of two million gallons, providing a comfortable reserve time for even the most catastrophic of steam power failures. This was over 100 times the meager reserve capacity of the two reservoir tanks within the Centre Square Engine House which provided a reserve time of less than an hour. An engine house with two steam engines (operating in parallel) could be built on the bank of the Schuylkill River to pump water up to the reservoir. Morris Hill was an ideal place to build a reservoir since it featured the highest elevation near the city.

The two men considered this option feasible and estimated the implementation cost to be $148,939[96] and the annual operating expense to be $8,360.[97]

Fourth: Is there a way to create a reservoir on the Schuylkill River or Wissahickon Creek by damming either one? Can water from either of these locations be brought into the city without

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[94] "An Act to enable the Governor of this Commonwealth to incorporate a company for opening a canal and water communication between the Rivers Delaware and Schuylkill, and for other purposes therein mentioned, passed 10 Apr 1792," *The Statutes at Large of Pennsylvania,* 313ff.

[95] "An Act to incorporate the union canal company of Pennsylvania, passed 2 Apr 1811," *Acts of the General Assembly of the Commonwealth of Pennsylvania* (Philadelphia: 1811), 226ff.

[96] The equivalent of approximately $3.3 million in 2022.

[97] The equivalent of approximately $189,000 in 2022.

using steam engines, perhaps by using the canal now under construction?

The changes to the canal company charters meant that this option could now be seriously considered as well. The Watering Committee needed to be able to compare the costs and feasibility of obtaining water by aqueduct or canal from sources upstream with the other alternatives. Davis and Graff considered this option feasible, if costly, with a huge up-front construction cost of $359,719[98] and an annual operating expense of $1,200.[99]

Davis and Graff summarized their report by directly comparing the estimated annual operating costs of each option with the no-build scenario of bringing the current system into a state of good repair (which, in any event, wasn't feasible). In this comparison, they didn't include the initial construction costs, but assuming the funds for construction would be borrowed they did include annual interest on the debt. They found that consolidated operations at the Schuylkill Engine House would cost $3,077 less per year to run,[100] operating an engine house and reservoir at Morris Hill would cost $2,614 less,[101] and operating a reservoir and aqueduct or canal would cost $2,873 more.[102]

It was clear that the third option, constructing an engine house and reservoir at Morris Hill, while not the least expensive of the lot, had the most promise dollar for dollar. It was far less expensive in terms of up-front costs than the in-river reservoir and aqueduct idea, provided more reserve capacity and growth capability than consolidating operations at the Schuylkill Engine House, and would not cause any interruption in the water supply during construction. The Watering Committee recommended it in its report to Councils on 2 May 1812.[103]

[98] The equivalent of approximately $8.1 million in 2022.
[99] The equivalent of approximately $27,100 in 2022.
[100] The equivalent of approximately $69,500 in 2022.
[101] The equivalent of approximately $59,000 in 2022.
[102] The equivalent of approximately $65,000 in 2022.
[103] Watering Committee, *Report of the Watering Committee Upon the Present State of the Works for Supplying the City with Water, and the Several Other Plans Proposed for the Purpose* (Philadelphia: Jane Aitken, 2 May 1812).

At Morris Hill the power for pumping was to be supplied by two steam engines within a new engine house to be constructed on the east bank of the Schuylkill River, located below the reservoir. In its report to Councils, the Watering Committee considered three alternatives for supplying steam power.[104] The first was to re-use both of the steam engines from the Schuylkill and Centre Square Works, moving one at a time to the new engine house at Morris Hill. The second was to move only the steam engine from the Centre Square Engine House to the new engine house and install a new one of the same type, a low-pressure engine. (With this alternative, the steam engine in the Schuylkill Engine House would be left in place and sold along with the building to a new owner who could re-purpose the facility as they wished.) The third was to acquire two new steam engines for Morris Hill. This last alternative was the one decided upon since the other two necessitated shutting down the current works and leaving the city without water for a dangerously long period of time (even if all went smoothly, which of course things rarely do). This was a situation the Watering Committee and Councils were keen to avoid.

The land available for a reservoir at Morris Hill was considerable. William Penn had called it "Faire Mount" and indicated it would have been the site for his home if he had not decided to settle on the Delaware River instead.[105] During the War for Independence, the British had built a fortification atop the site,[106] part of a string of such defenses stretching between the

[104] Watering Committee, *Report of the Watering Committee Upon the Present State of the Works for Supplying the City with Water, and the Several Other Plans Proposed for the Purpose* (Philadelphia: Jane Aitken, 2 May 1812).
[105] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 7.
[106] John Montrésor, Plan of the City of Philadelphia and its Environs showing its Defences [sic] During the Years 1777 & 1778; Henry Cabot Lodge, ed., *[Major John] André's Journal, an authentic record of the movements and engagements of the British Army in America from June 1777 to November 1778,* Vol. I (Boston: Bibliophile Society, 1904), 135; Lewis Nicola, *Plan of the English Lines Near Philadelphia, 1777* (1778), courtesy Historical Society of Pennsylvania. During the British occupation of Philadelphia, the fortification atop Fairmount contained two iron canons capable of firing 18-pound shells. See John Montrésor, *Return of the Number and Nature of Ordnance in the severall [sic] Redoubts, Philadelphia* (1 Dec 1777), courtesy Montrésor Family Archives on Microfilm (1993).

Schuylkill and Delaware Rivers just north of the city. Since that time it had become known as Morris Hill, after the name of its famous former owner, Robert Morris, one of the signers of both the Declaration of Independence and United States Constitution.[107]

When John Davis was still Superintendent of the Schuylkill and Centre Square Works some ten years earlier, he had been asked by Henry Drinker, Cashier of the Bank of North America and member of the Watering Committee, to provide oversight of a quarry operation on the south side of Morris Hill. The quarry had once been owned by Robert Morris, but the bank had possessed the Morris Hill property and the quarry ever since Morris' finances had collapsed a few years prior. The quarry was selling stone to the builders of the Permanent Bridge connecting High (Market) Street across the Schuylkill River and Drinker wanted to ensure they were being paid a fair price.

Part of Davis' job at Morris Hill was surveying the property, so he got to know every inch. Because the view was spectacular, he sometimes climbed to the crown to eat a packed lunch on the embankment of the fort that still survived there. From his perch, "the highest ground

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[107] Robert Morris was the most prominent financier of the American Revolution. In addition to his primary residence on High Street (today's Market Street) between 5th and 6th Streets, Morris had owned a large tract of land which included the area along the east side of the Schuylkill River from the location of the present-day Spring Garden Street Bridge on the south to the location of the present-day Girard Avenue Bridge to the north. He called it "The Hills." It included what is now known as Fairmount, Lemon Hill, and the Sedgley tract, as well as the Springettsbury estate which included much of what is now known as the Fairmount neighborhood to the east of the current CSX rail line. On what would later be called Lemon Hill, Morris built a two-story mansion of stone (not the current Lemon Hill mansion), gardens, fish ponds, farming fields, orchards, and extensive greenhouses for exotic plants and fruit trees; he and his family used it as a summer retreat. He operated a quarry at the southwest corner of Fairmount. The primary approach to the property and mansion was from the south via a drive that passed between the river's edge and the cliff face of Fairmount (through what is now the South Garden and Forebay areas), proceeded northward (along the location of the current Waterworks Drive), across a low-lying flatland between Fairmount and Lemon Hill (an area which would later become known as the Flat Iron), past the current location of the Lincoln Monument, and up and around the east side of Lemon Hill (along the location of the current Sedgley Drive). Morris lost all of his property, including The Hills and a much-ridiculed unfinished mansion on the south side of Chestnut Street between 7th and 8th Streets (known even at the time as "Morris' Folly"), in a series of sheriff's sales and auctions from 1797 to 1801 as a result of personal and professional financial collapse due to severe overextension and indebtedness on a complex array of financial speculations. See Thomas Westcott, *The Historic Mansions and Buildings of Philadelphia* (Philadelphia: Porter & Coates, 1877, 1894; Walter H. Barr, 1895), 367ff; Ryan K. Smith, *Robert Morris's Folly: The Architectural and Financial Failures of an American Founder* (New Haven: Yale University Press, 2014), 45f, 73, 81, 164ff, esp. 182.

around the City," he could clearly see the Schuylkill and Centre Square Water Works some two miles away. Davis knew that the citizens of Philadelphia would soon outgrow the current system and it occurred to him that Morris Hill would be an ideal location for a reservoir. Davis let Drinker know about his thoughts at the time.[108]

Appropriately, Davis did not include his personal experiences atop Fairmount in the professional evaluation of alternatives he and Graff submitted to the Watering Committee. In any event, Councils approved the proposal and the Watering Committee wasted no time getting started. The Committee acted upon the decision so quickly, in fact, that purchase of the entire property necessary for the new works was not completed until after construction began. The first purchase of property at Morris Hill by the City of Philadelphia from the owners, Jonathan Williams[109] and Thomas Morris,[110] was made on 28 Jun 1812.[111] Construction commenced on the first of August[112] but the deed for the entire property was not acquired by the City until the

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[108] John Davis, *Autobiography of John Davis* (Jan 1851), published in *Maryland Historical Magazine*, Vol. 30, No. 1 (Baltimore: Maryland Historical Society, Mar 1935), 21f.

[109] A grand-nephew of Benjamin Franklin, Williams assisted Franklin in his diplomatic mission in France during the Revolutionary War. The first superintendent of the Military Academy at West Point, he was later appointed Chief Engineer of the U.S. Army Corps of Engineers. At this time he was retired from the Army and was leading a volunteer force of engineers designing and constructing defensive fortifications around Philadelphia. See "Commanders of the Corps of Engineers," *U.S. Army Corps of Engineers*, <www.usace.army.mil/About/History/Commanders>, accessed 8 May 2020.

[110] Robert Morris' second-oldest son and one-time U.S. Congressman from New York was at this time practicing law in New York City. In 1796 and 1797 he had negotiated a landmark peace treaty with the Seneca and other members of the Iroquois Nation in upstate New York. Ryan K. Smith, *Robert Morris's Folly: The Architectural and Financial Failures of an American Founder* (New Haven: Yale University Press, 2014), 128ff, 157f, 160f.

[111] Watering Committee, *1852 Annual Report* (6 Jan 1853), 47. The purchase price is listed as $16,666.67.

[112] Watering Committee, *1812 Annual Report* (5 Nov 1812); Watering Committee, *Chief Engineer's 1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and *History of the Water Supply of Philadelphia,* supplement to Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 19. The Annual Report for 1812 states, "Contracts have been entered into in August and September, executed in the latter month and beginning of October following for pipe, timber, digging of the reservoirs, for all the castings for the engine and boiler, for making a new engine, and for quarrying stone on the spot, at the foot of Fair-mount, where the engine house is to be erected, for which purpose the ground has been cleared and the works are now progressing." The Annual Reports for 1849 and 1875 both specify 1 Aug 1812 as the date construction began.

25th of the month.[113]

After submitting the report with Graff, Davis was paid $150[114] for "services rendered, in planning and estimating as per report to Councils, for altering the system for supplying the city with water."[115] Frederick Graff's work on the report was considered part of his job as superintendent and chief engineer. He received the proverbial firm dry handshake but nothing more.

In fact, Graff did receive more, but not in the way of compensation. Following Councils' decision to authorize the Watering Committee to embark on the upgrade of the city's water supply system, Graff was given the task of designing and supervising construction of the new system with only the barest of outlines regarding specifics, all in addition to his current responsibility of supervising the old Schuylkill and Centre Square Works until it was replaced.[116] With less than four months between the Watering Committee submitting their recommendation to Councils and the start of construction, Frederick Graff must have been very busy indeed.

By the time Frederick Graff had been given the helm of the Schuylkill and Centre Square Works at the age of 29 in 1805 he had developed into a brilliant engineer in his own right. Now in his mid-thirties, all of his experience as a carpenter's apprentice and draftsman under Latrobe, as well as the practical engineering knowledge gained while maintaining the old system and

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[113] *Deed* (25 Aug 1812), possession of Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation. The City of Philadelphia purchased two plots of land from Messrs. Williams and Morris under the agreement of sale: "Containing in Breadth four hundred feet and in length or depth four hundred feet, bounded northward b y Hunter Street, eastward by Pearl Street, southward by Morris Street, and westward by Bridge Street. And also all that Certain lot or piece of ground situate on the west side of Bridge Street and north side of Morris Street aforesaid containing in breadth on the said Bridge Street two hundred and twenty five feet and extending from the said Bridge Street westward in length or depth the breadth aforesaid (crossing a thirty feet wide Street into the Schuylkill River) low water mark bounded northward by other ground of the side Jonathan Williams and Thomas Morris eastward by Bridge street aforesaid southward by Morris street and westward by the Schuylkill."
[114] The equivalent of approximately $3,400 in 2022.
[115] Watering Committee, *1812 Annual Report* (5 Nov 1812).
[116] Henry Simpson, *Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 341ff; James F. O'Gorman, et al., *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986,* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts, 1986), 43f.

designing workable solutions to vexing problems, was brought to bear on the design of a system at Fairmount. Graff designed every aspect of the new works—the system layout, pumps, discharge mains, reservoirs, fittings, architecture—everything except the steam engines themselves.

Graff designed the system at Morris Hill (now increasingly called Fair Mount or Fairmount) so that water from the Schuylkill River would flow by gravity through a short channel, perpendicular to the river bank and dug out of bedrock, into the well of a double-acting pump at the lower level of the Engine House. The pump, powered by either of two steam engines, would force the water through a 239-foot-long, 16-inch-diameter iron ascending main up to the reservoir atop Fairmount, 102 feet above the level of the river at high tide.[117] From there, water would flow by gravity through wood mains to the iron distribution chest at the Centre Square Engine House, and from there throughout the existing distribution system to subscribing homeowners and businesses, as well as to public hydrants and pumps.

One of the things Graff's experience operating the Schuylkill and Centre Square system taught him—doubtless the hard way—was the absolute necessity for the structure of the building to accommodate the operation of the machinery. He was well aware of the danger posed by a crowded interior in a pumping station; it is probable that he had chalked up at least a few "near misses" as he dodged the moving beams and other components at the Centre Square Engine House. Latrobe's design of the building had been focused on the classical architecture of the exterior, crowding the machinery into too small a space and making it dangerous to operate.

For the Engine House at Fairmount, Graff did borrow from Latrobe's design philosophy of using a handsome exterior to conceal the machinery within, but he ensured the interior would

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[117] Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.

have plenty of space for the two steam engines. Since steam engines were still considered dangerous—a valid perception, as we will soon see—Graff designed the exterior to present an entirely nonthreatening appearance. From the outside, the Engine House would look like a private home, a graceful country villa in the Federal style, seemingly three stories tall with the traditional central entrance flanked on either side by windows, chimneys, and other features carefully arranged in bilateral symmetry. For the interior space Graff designed an open plan with no floors or wall partitions from the "basement" to the roof rafters. In essence, the building was a box three stories high, with two smaller, one-story boxes, one on either side. The two steam engines with their flywheels, lever beams, and other equipment were accommodated in the main central space, within which there was no "main floor," only the stairs needed for access to the various components of the engines. The boilers, one for each engine, would be located in the side spaces, called the Boiler Sheds.[118]

Graff placed the Engine House on the very edge of the east bank of the Schuylkill River, in the narrow space between the river and the west face of Morris Hill (Fairmount), just upstream of where the Upper Ferry carried passengers and cargo across the river. The quarry at the south side of Fairmount, near the eastern landing of the ferry, supplied stone for the structure. This often delayed construction when blasting interfered with the work of the masons, at times making it impossible for them to work.

Construction continued through the autumn of 1812 and into the spring of 1813. The channel from the river to the pump well was dug out of bedrock by hand with great difficulty and needed to be done behind a cofferdam,[119] forcing construction of this component to wait until the

[118] Watering Committee, *1814 Annual Report* (11 Jan 1815), 5, 6 (for example).
[119] A partition-like structure designed to allow work below the waterline.

better weather of springtime.[120]

Concerned about potential erosion of the foundation of the original river wall from freshets[121] and ice floes, in 1814 Graff constructed a second river wall ten feet out from the riverside face of the Engine House and created a narrow porch overlooking the river above the resulting space between the two.[122] By the end of 1814, the Engine House had been fully erected but neither of the steam engines was yet installed. Construction of the reservoir atop Fairmount was now under way as well.[123]

The Watering Committee procured a new Boulton & Watt-type, low-pressure steam engine from Samuel Richards, whose Eagle Works had produced iron and brass castings for the Centre Square Works and had supplied cylindrical iron bands used to join sections of the wooden water mains.[124] On 3 Oct 1812, the Committee contracted with Richards "to make and furnish all cylinders and castings which may be necessary for the constructing of the steam engine intended to be erected at Fair Mount, and also the cylinders and castings which may be necessary for the pipes of conduit," conforming to specifications furnished by the Watering Committee, and deliver the engine within three months.[125] Richards seems to have produced most of the components at his Eagle Works foundry on Callowhill Street at the Schuylkill River,[126] a little

[120] Watering Committee, *1813 Annual Report* (11 Nov 1813), 4; Watering Committee, *1814 Annual Report* (11 Jan 1815), 5, 6.
[121] Sometimes used synonymously with the word "flood," a freshet is high water in a river or stream due to heavy rain or spring snow melt. Freshets can be quite severe, resulting in flooding. See "Freshet," *Merriam-Webster.com Dictionary* (2022), <www.merriam-webster.com/dictionary/freshet>, accessed 17 Aug 2022.
[122] Watering Committee, *1814 Annual Report* (11 Jan 1815), 5. The additional river wall was built four feet thick. The ceiling above the space between the original and additional walls was vaulted. This wall can today be observed as the west wall of the lower level corridor in the Engine House.
[123] Watering Committee, *1814 Annual Report* (11 Jan 1815), 4f.
[124] Watering Committee, *1802 Annual Report* (1802), 7. Samuel Foxall operated the Eagle Works at the time. (The Eagle Works was operated as late as 1810 by Samuel Foxall; by 1812 Samuel Richards was the operator.) The cast iron joints cost $80 per ton.
[125] *Contract with Samuel Richards* (3 Oct 1812), City of Philadelphia Archives.
[126] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 40, 40n58. The Eagle Works was operated as late as 1810 by Samuel Foxall; by 1812 Samuel Richards was the operator.

less than a quarter mile downstream of Fairmount, and some at his Weymouth Foundry near Mays Landing in New Jersey.[127] The cost of each of the components varied according to the weight of the article, ranging from $90 to $160 per ton,[128] depending on the difficulty of its production. For example, the cast iron boiler plates cost $90 per ton, the flywheel and shaft components $100 per ton,[129] the lever beam $120 per ton,[130] and the cylinder castings $160 per ton.[131] Altogether, the City paid $54,341[132] for the entire engine.[133]

The procurement process, however, saw the by-now-familiar pattern of difficulties with fabrication causing delays in delivery, installation, testing, and operation. On 15 Oct 1813, over nine months past the contracted date for the delivery of the engine, the Watering Committee's frustration with the delay reached the breaking point and the City of Philadelphia sued Richards over the repeated unsuccessful attempts by his foundry to produce a particular casting for the engine's air pump. It was a seemingly minor issue but was indicative of a larger problem. In response, Richards laid off his workmen and stated that he didn't care who supplied casting. The Watering Committee then ordered an entire air pump from Oliver Evans, whose Mars Works foundry apparently produced it without too much difficulty since he was paid $216[134] on 1 Jan 1814.[135] A judge eventually found in favor of the Watering Committee and advised it to "hold up payment [to Richards] to cover indemnity."[136]

[127] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 7.
[128] The equivalent of approximately $2,000–3,600 in 2022.
[129] The equivalent of approximately $2,200 in 2022.
[130] The equivalent of approximately $2,700 in 2022.
[131] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 5f.
[132] The equivalent of approximately $1.2 million in 2022.
[133] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6.
[134] The equivalent of approximately $3,600 in 2022.
[135] Watering Committee, *1815 Annual Report* (25 Jan 1816).
[136] *Case Before Judge Hathaway, City v. Samuel Richards* (25 Oct 1813), City of Philadelphia Archives. Oliver Evans was paid $215.62 on 1 Jan 1814 "for air pump."

Known as the "great English engine,"[137] it was installed in the south end of the main space within the Engine Room. The South Engine was similar in overall design to that in the Schuylkill Engine House,[138] but the working beam, shafts, and flywheel arms were made of cast iron instead of wood.[139] The working beam measured 23 feet, 9 inches, from center to center of the outside pivot points; it was so large for its time that it had to be cast in two leaves. The cylinder was a little over 3½ feet in diameter and over 6 feet long. Richards reported that casting the cylinder utilized every bit of the Eagle Works' capacity; it required 1¾ tons of iron, all that the foundry could heat to molten liquid and pour at one time.[140]

The engine's boiler, housed in the South Boiler Shed,[141] consisted of a cast iron case with vertical wrought iron flues.[142] It initially supplied steam to the engine at 2½ times atmospheric pressure, later at four times atmospheric. The engine drove a pump which was 20 inches in diameter and, like the engine's piston, had a six-foot stroke. Like the earlier pumps, the pump at Fairmount was double-acting, meaning it pushed water as its piston moved in both directions.[143]

While Graff was conducting the hands-on work of planning, designing, and overseeing the construction of the new Fairmount Water Works—even serving as his own draftsman, producing his own engineering drawings—he was still expected to maintain his role as superintendent of the Schuylkill and Centre Square Works. The workload and pressure must have been intense. Recall that even prior to being given the task of standing up an entirely new

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[137] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 38. The South Engine is believed to be the engine in the working-drawing titled "North Face Section of Engine Building at Fair Mount," in the Graff Collection at the Franklin Institute.
[138] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 5.
[139] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6.
[140] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6.
[141] The relatively narrow space spanning the south side of the Engine House, consisting of a lower (basement) level and ground floor. The corresponding space on the north side of the building is called the North Boiler Shed.
[142] Watering Committee, *1852 Annual Report* (6 Jan 1853), 26.
[143] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6.

water pumping and distribution system for the citizens of the City of Philadelphia, his responsibilities at the old works alone had kept him away from home a great deal. Far greater responsibilities had now been piled upon him without any increase in regular compensation.

In 1813 the Watering Committee did decide to give Graff a bonus of $1,000,[144] with half to be paid that year and half when the new works at Fairmount were completed. Even at that, a quarter of the bonus had to go toward replacing his personal professional instruments which had been stolen from the onsite office. When the work at Fairmount began, the Watering Committee had directed Graff to purchase all new instruments for himself at the City's expense, but they now expected him to pay the replacement cost out of his own pocket.

Graff's salary, moreover, was the same as when he was first hired as superintendent in 1804—$1,200 per year. During the intervening years, inflation had trundled along at an average rate of 3.44 percent, eroding his salary's purchasing power bad enough. In 1813, however, because of events surrounding the War of 1812, inflation rose to 20.3 percent. Graff would have needed his annual salary raised to $1,627—an increase of 35 percent—to maintain the same purchasing power as he had in 1804.[145]

Eventually Graff had enough. On 3 Mar 1815 he submitted his resignation as superintendent. Surprisingly, the Watering Committee accepted it and advertised for Graff's replacement in newspapers in the local area as well as in New York and Baltimore. When no one expressed the slightest interest in the job, a chastened Watering Committee offered to double his bonus and raise his salary to $2,000 per year,[146] beginning the first of the year in 1815.[147] It

[144] The equivalent of approximately $18,500 in 2022.
[145] *CPI Inflation Calculator* (2022), <www.in2013dollars.com/us/inflation/1804?endYear=1813&amount=1200>, accessed 4 Oct 2022.
[146] The equivalent of approximately $38,500 in 2022.
[147] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 4.

would not be the last time Graff's dedication was taken for granted, nor the last time he would need to bring the Watering Committee's presumption to its attention.[148]

The installation of the steam engine was eventually completed and testing begun. Workmen could not at first get the boiler to produce the 2½ pounds of steam necessary to operate the engine and it eventually stopped. After enlarging the chimney flue, however, the boiler was able to produce up to four pounds of pressure, enough for the engine to work properly.[149] The day the first cell of the Fairmount Reservoir was finished, 7 Sep 1815,[150] the steam engine began pumping water up to it in regular operation[151] through an iron ascending main 16 inches in diameter and 239 feet long.[152] From the reservoir, 102 feet above the Schuylkill River at high tide,[153] water flowed through a set of five wood mains, four with an interior diameter of 6 inches and one with an interior diameter of 4½ inches, 1.8 miles to the distribution chest at Centre Square[154] and from there throughout the developed portion of the City of Philadelphia. The Fairmount Water Works was open for business.

In recognition of Graff's work in designing the nascent Fairmount system—not to mention his double duty as superintendent of the old works— sometime around the New Year in

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[148] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 433.
[149] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6.
[150] Watering Committee, *1815 Annual Report* (25 Jan 1816), 3; and Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 8 ("Statistics Relating to Fairmount Water Works").
[151] Watering Committee, *1815 Annual Report* (25 Jan 1816), 3; Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.
[152] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6; and Watering Committee, *1852 Annual Report* (6 Jan 1853), 26.
[153] Frederic Graff, Jr., *Notes Upon the Water Works, 1801–1815* (Philadelphia: The Franklin Institute, 1876), 6; and Watering Committee, *1852 Annual Report* (6 Jan 1853), 26. The phrase "102 feet above low tide" is probably a clerical error which has been perpetuated and should read "102 feet above *high* tide."
[154] Watering Committee, *1815 Annual Report* (25 Jan 1816), 4. Watering Committee, *1852 Annual Report* (6 Jan 1853), 27. The distance from the Fairmount Reservoir to the distribution chest at Centre Square was 9,537 feet. A fifth six-inch wood main would be added within two years.

1816 the Watering Committee presented him a silver vase costing $245.[155] The inscription read:

> This vase is presented, on behalf of the city of Philadelphia, by the Watering Committee of the Councils, to Frederick Graff, to express their admiration of the taste, judgment, and fidelity with which he arranged and assisted in prosecuting to a conclusion, the Public Works at Fair Mount.[156]

The same day the Fairmount Water Works began operating, the Schuylkill and Centre Square Works was abandoned as a water pumping and distribution system.[157]

The steam engine in the Centre Square Engine House was shut down immediately, although it was three years before it was sold off.[158] Suggestions for the facility's adaptive reuse came and went over the next few years.[159] In 1818 the American Philosophical Society proposed to convert the engine house into an astronomical observatory, going so far as to hire the prominent architect William Strickland (like Graff, a one-time student of Latrobe) to create plans, but nothing came of the idea.[160] Philadelphians seemed to have grown fond of the building and were reluctant to part with it,[161] but in the end nothing was done. The below-ground distribution chest on the east side of the Centre Square Engine House continued to be used as a

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[155] The equivalent of approximately $5,100 in 2022.

[156] Henry Simpson, Lives of Eminent Philadelphians, Now Deceased (Philadelphia: William Brotherhead, 1859), 436.

[157] Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.

[158] Watering Committee, *1818 Annual Report* (14 Jan 1819), 3.

[159] *Poulson's American Daily Advertiser* (Philadelphia: 22 Nov 1817). Cited in James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 64f.

[160] *Treasurer's Accounts,* 1816–1829, American Philosophical Society; *Transactions of the American Philosophical Society,* n.s., 1 (1818), xvi–xvii; *Proceedings of the American Philosophical Society,* Vol. 22, No. 119, Part 3 (Jul 1885), 463ff, 476f. Cited in James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 64f.

[161] Cited in James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 65.

hub for distributing water from Fairmount[162] until it was bypassed in 1829.[163] The building was finally demolished later the same year.[164]

The Schuylkill Engine House and adjoining mill, which had caused so much trouble for the operating partnership of Benjamin Latrobe, Nicholas Roosevelt, and the Bollmann brothers—not to mention the Watering Committee—until it closed in 1806, fared slightly better. The Bollmann brothers' share of the mill was sold at auction to the family of Eric Bollmann's late wife. Eric had been hoping to be kept on as manager, but never had good relations with his wife's side of the family so he withdrew from consideration.[165] William Ellis Tucker purchased the mill in 1825 and converted the complex into the Tucker and Hemphill Hard Porcelain Manufactory.[166] The factory produced porcelain, china, and pottery until 1838 when after a series of commercial buyouts[167] it was closed and demolished.[168]

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Although the Fairmount Water Works was up and running, the single steam engine in

162 Watering Committee, *1815 Annual Report* (25 Jan 1816), 4; John A. Paxton, *The City of Philadelphia for the Use of Firemen and Others,* map (Philadelphia: 1817).
163 *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 29.
164 Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 47 ("Date of important events…"); Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9.
165 Fritz Redlich, "Notes and Documents: The Philadelphia Water Works in Relation to the Industrial Revolution in the United States," *The Pennsylvania Magazine of History and Biography,* Vol. 69, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 1945), 249.
166 Edwin A. Barber, "The Tucker and Hemphill Hard Porcelain Manufactory, Philadelphia 1825–1838," *Bulletin of the Pennsylvania Museum,* Vol. 4, No. 14, 1 Apr 1906, 17ff.
167 Edwin A. Barber, "The Tucker and Hemphill Hard Porcelain Manufactory, Philadelphia 1825–1838," Bulletin of the Pennsylvania Museum, Vol. 4, No. 14, 1 Apr 1906, 21. Accessed via JSTOR at <www.jstor.org/stable/3793797?seq=1#page_scan_tb_contents>, 29 May 2018.
168 Jeffrey A. Cohen and Charles E. Brownell, *The Papers of Benjamin Henry Latrobe, Series II, The Architectural and Engineering Drawings, Vol. 2, The Architectural Drawings of Benjamin Henry Latrobe,* Part 1 (New Haven and London: Yale University Press for the Maryland Historical Society and The American Philosophical Society, 1994), 231.

operation was barely reliable enough. If run continuously it had the capacity to pump a little over 2,100,000 U.S. gallons to the reservoir in a 24-hour period, but because the boiler and pump were both "leaky and defective,"[169] the engine rarely ran more than 12 hours out of each day. In 1819 Graff reported that the South Engine never raised more than 1,718,000 gallons in a day.[170]

In any event, the Fairmount Water Works was never meant to work with only one steam engine. Over a year before the first engine was operational, Graff and the Watering Committee had already begun the procurement of the planned second engine.

Because of the problems with the low-pressure, Boulton & Watt-type steam engine installed in the south end of the main space within the Engine House, Graff investigated the possibility of installing a new type of engine in the north end, a high-pressure steam engine which Oliver Evans had recently developed. Graff lived on North 6th Street in the heart of the mechanics community and had probably seen Evans' engines either in operation or during construction at Evans' Mars Works just a few blocks to the north and west at 9th and Vine Streets. The two also had mutual friends.[171]

Evans replied to Graff and offered to provide a high-pressure engine for use at Fairmount with the guarantee that if it did not prove satisfactory he would remove it and repay monies to the city.[172] In return, he would get a bonus if it performed above expectations. The Watering Committee and Councils reviewed the proposal and contracted for Evans' "Columbian High

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[169] Watering Committee, *1815 Annual Report* (25 Jan 1816), 3.
[170] Frederick Graff to Joseph S. Lewis, 4 Feb 1819.
[171] Ferguson, *Reminiscences of George Escol Sellers,* 63. Also, Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (New York: Arno Press, 1872), 246. Jacob Perkins, William Sellers, and Dr. Robert Patterson, for example.
[172] Oliver Evans to Watering Committee, 21 May 1814. Text of letter in Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 211ff.

Pressure Steam Engine" on June 9, 1814.[173] Evans was paid $5,000[174] the day the contract was signed. In addition, the contract provided for Evans to be paid $9,000[175] when the engine was ready for delivery and another $9,000 when the engine had demonstrated its specified capability—3½ million ale gallons[176] of water, 17,797 tons, pumped up to Fairmount Reservoir per day.[177] If all were well, the City would pay a total of $23,000.[178] Evans commenced construction of the steam engine at his Mars Works.[179]

A genius inventor, Oliver Evans (1755–1819) grew up in Delaware and became a millwright early in life. He developed and patented an "Automated Flour Mill," a mechanized marvel which required no manual transfer of materials and could be operated by a single miller and an assistant. Although the design was very successful—automated mills were built throughout the northeast United States, including for George Washington and Thomas Jefferson—it was pirated and many automated mills were constructed without earning Evans anything.[180] In Philadelphia, Evans began the Mars Works, the city's first significant foundry, in 1807.[181] His "Oructor Amphibilos,"[182] was a steam-powered, self-propelled vehicle, that operated both on land and in water. His later life was substantially occupied with patent disputes. In many ways far ahead of his time, Evans was a visionary whose conceptions were often not

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[173] Watering Committee, *1812 Annual Report* (25 Jan 1816), 4.
[174] The equivalent of approximately $84,100 in 2022.
[175] The equivalent of approximately $151,500 in 2022.
[176] An ale gallon is equal to 1.22 modern U.S. gallons (282 cubic inches, 162 fluid ounces, or 4.62 litres). If we know that an ale gallon of water weighs 10.17 pounds (at 62°F/17°C), we can easily calculate that Evans' engine was contracted to pump approximately 17,797 tons of water up to the reservoir (102 feet above high tide) each day.
[177] Watering Committee, *1814 Annual Report* (11 Jan 1815).
[178] Oliver Evans to Watering Committee, 21 May 1814. Text of letter in Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 211ff. The amount was the equivalent of approximately $387,000 in 2022.
[179] "History of the Steam Engine in America," *Journal of the Franklin Institute*, Vol. 102, Nos. 607–612, Series 3, Vol. 72, Jun–Dec 1876 (Philadelphia: The Franklin Institute, 1876), 266.
[180] <www.oldwyemill.org>
[181] Ross Thomson, *Structures of Change in the Mechanical Age: Technological Innovation in the United States, 1790–1865* (Baltimore: Johns Hopkins University Press, 2009), 34f.
[182] Greek for "amphibious digger."

practicable or achievable during his lifetime because of the technical limitations of the day.[183]

In 1801 Evans designed and constructed a new type of steam engine which represented a significant advance over the engines in use up to that time. Evans' engine operated at a much higher pressure; it was more efficient and had greater power output. In order to understand what was significant about Evans' design, it will be helpful to review the various types of early steam engines and their development up to this time.

The earliest device using steam to move something substantial was created by Edward Somerset (1602–1667), the Second Marquess of Worcester[184] in 1663 after working on it for some thirty years. Thomas Savery (c.1650–1715) devised a similar engine in 1698. Both engines used steam under low pressure to pump water; neither used a piston. Low-pressure steam was introduced into an airtight container. When small amounts of water were poured over the outside of the container, the steam condensed, forming a partial vacuum which pulled water into the container. (It is more accurate to say that the higher atmospheric pressure outside the container pushed the water into the partial vacuum inside the container.) As steam was again introduced into the cylinder, it forced the water out though a discharge pipe. In this way the engine was first used to pump water out of mines. The partial vacuum created by the condensing steam inside the cylinder was able to raise water approximately 20 feet and the reintroduction of steam could force the water somewhat higher, but the high steam pressures necessary to force the ejected water to any significant height required by mines (which could reach depths of a few hundred feet by this time) were beyond the capability of the boilers of the time. The Worcester engine disappeared after 1670; the Savery engine was not commercially viable for mine pumping, but

[183] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884* (Philadelphia: L. H. Everts & Co., 1884), 521f.
[184] Pronounced "WOOS-ter," with the double-O as in the word "book."

was used throughout the 1700s for pumping water under heights of 20 feet.

In 1712, Thomas Newcomen (1663–1729) developed a new type of steam engine featuring a piston closely fitted within a smooth-bored cylinder. In this engine, low-pressure steam is admitted into the cylinder. Instead of pouring water over the outside of the cylinder, a water spray is injected into its interior. As the water spray is injected the steam condenses, forming a partial vacuum which “sucks” down the piston inside the cylinder. (Again, it’s more accurate to say that the higher atmospheric pressure on the outside of the cylinder forces the piston down into the partial vacuum.) The piston is connected by a chain to one end of a beam (called a working beam) with a pivot fulcrum in the middle (like a see-saw or teeter-totter). The other end of the working beam is connected by a chain to a pump piston. As the end of the working beam connected to the steam piston is drawn down, the other end is forced up. This draws the pump piston up, drawing water with it. At the end of this power stroke, the weight of the pump piston and chain pulls the pump end of the working beam down again. As it does so, the steam piston end of the beam is raised. This draws the steam piston up, which readies the cylinder for introduction of steam once again. Scalable larger or smaller for varying needs, the Newcomen Engine was commercially successful. It was widely used for mine drainage throughout Britain by 1725.

Many today think of James Watt (1736–1819) as having invented the steam engine, but this isn’t the case; it was developed before he was even born. What Watt did do, however, was greatly *improve* the steam engine. Of course, this was no mean feat either. Despite Watt’s brilliance, it took him 20 years to accomplish what he did. His advances were so difficult and required so much experimentation by trial and error that were it not for the financial backing and encouragement of manufacturer Matthew Boulton, success would probably have eluded him.

Watt introduced three innovations. First, although it was a condensing (or atmospheric) engine, like those before it, he moved the condenser out of the steam cylinder into a separate condenser cylinder. This allowed the steam cylinder to be continuously maintained at a high temperature. Not needing to reheat the steam cylinder after each condensing step doubled the thermal efficiency of Watt's engine over the Newcomen engine, increasing its capacity.

Second, Watt made the cylinder double-acting. With Newcomen's engine, the power stroke was only in one direction, when atmospheric pressure forced the piston down into the partial vacuum formed by the condensing steam. Watt changed the design to introduce live steam into both ends of the cylinder, alternating between one side of the piston and the other. As valves were opened to the air on the side of the piston opposite to where the steam was, as the steam condensed, atmospheric pressure pushed the piston into the partial vacuum formed by the condensing steam. In this way, the piston created a power stroke in both directions instead of only one, as the vacuum alternating on either side sucked the piston first one way and then the other. Combined with a double-acting pump, this greatly increased the number of strokes which could be achieved per minute and further increased the capacity of the engine.

Third, Watt modified an existing flyball governor device, commonly found in milling operations, and adapted it to regulate the engine's speed. It did so by adjusting the amount of steam supplied to the engine. In other words, he created the first feedback governor. This enabled self-regulation, not merely automation. Newswomen's engine was automatic; Watt's was self-regulating.

As a commercial endeavor, the Boulton & Watt engine (as it was marketed) was wildly successful. With the addition of a flywheel, the engine's reciprocal motion was transformed into rotary motion for powering rotating shafts. Five hundred were built by Boulton & Watt and by

their licensees under patent between 1775 and 1800. (Of these, about 300 were used to drive rotating shafts and about 200 powered reciprocal pumps.) Close to this number were built by others pirating the design in violation of the patent. Boulton & Watt-type engines were the type constructed and installed in the Schuylkill and Centre Square Works as was the first engine installed at Fairmount in the south end of the Engine House.

Around 1800, Richard Trevithick (1771–1833) in Britain and Oliver Evans in the United States, working independently and without knowledge of the other, developed the revolutionary high-pressure steam engine. Dispensing with the condenser altogether, high-pressure steam is introduced into alternating ends of the steam cylinder. Instead of atmospheric pressure pushing the piston into a partial vacuum created by condensing steam, as with the low-pressure engine, the piston is pushed by live steam at higher than atmospheric pressure. This was a dramatic advance over the Boulton & Watt engine. No longer a condensing (or atmospheric) type, the new design resulted in much higher efficiency and greater power and allowed the engine to be smaller and lighter for any given output.[185]

Evans introduced another innovation which became widely used, the "Evans straight-line linkage" as it came to be called. Instead of arranging the steam cylinder's piston rod and the driveshaft leading to the pump on opposite ends of the working beam, he placed them on the same end. This allowed the working beam to be much lighter, making his engine still more compact and therefore more powerful for its weight.[186]

In 1801 Evans operated a small high-pressure steam engine in his shop as a

[185] Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900* (New York: Oxford University Press, 1967), 245ff; Abbott Payson Usher, *A History of Mechanical Inventions,* Revised ed. (New York: Dover Publications, 1982), 342ff.
[186] Eugene S. Ferguson, "Kinematics of Mechanisms from the Time of Watt," *Contributions from the Museum of History and Technology,* Bulletin 228, Paper 27 (Washington, D.C.: United States National Museum, 1962), 200ff.

demonstration model; it powered a rotary crusher to grind limestone for plaster and agricultural uses. He exhibited his high-pressure steam engine design in 1805 by using one to power his Orukter Amphibolos. Ordered by the Board of Health to dredge silt from the wharf area on the Delaware River, Evans drove the vehicle up Market Street from his Mars Works near the eastern end of the thoroughfare, circled Centre Square (where City Hall stands today), and continued up Market to the Schuylkill River. He then navigated down the Schuylkill—powered by steam—to the Delaware River and on up the Delaware to the docks where he landed on the east end of Market Street near where he began. Although technically successful as an amphibious vehicle, it was not successful as a dredge and was never used again.[187] Evans' high-pressure engines were successfully used, however, in milling and boring operations. By 1812 Evans had built and sold ten of the Columbian Engines, as he patriotically called them, with six more in various stages of construction.[188]

Graff and the Watering Committee anxiously awaited the delivery and installation of Evans' engine, after which the first engine could be safely shut down so at least some of its deficiencies could be addressed. At Fairmount the large capacity of the reservoir—over 3¼ million gallons initially—meant there was a little over 3½ days of reserve capacity.[189] Compared to less than an hour's reserve with the old Schuylkill and Centre Square system, that kind of breathing room must have seemed like a lavish luxury to Graff.

Oliver Evans delivered his high-pressure Columbian steam engine in March 1815. It was installed in the north side of the main central space of the Engine House, opposite the Boulton and Watt low-pressure engine on the south side. The new engine's boilers operated in the North

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[187] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 237.
[188] Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900* (New York: Oxford University Press, 1967), 260.
[189] Watering Committee, *1815 Annual Report* (25 Jan 1816), 4.

Boiler Shed. As with the South Engine, installation and assembly was a long and laborious process. There were no powered heavy-lift machines or power tools. Large components were lifted into place with wood cranes using the compound pulley systems of block and tackle. Men installed and assembled the components by hand with hook spanners and spud wrenches.[190] It was dangerous, labor-intensive work.

In mid-July 1816, while installation of Evans' engine was just being finished, two of the valve seats for the low-pressure South Engine's pump blew out, rendering it inoperable. The entire system had to be shut down while repairs were made. From a water supply standpoint, this was a potentially catastrophic situation. Although it had not yet been fully tested and formally accepted, Evans' engine was pressed into service and operated until the first engine's pump was repaired. Not coincidentally, the Watering Committee turned to Evans to get the South Engine back into operation.[191]

At the same time, the channel beneath the Engine House leading from the Schuylkill River to the pumps was deepened. This is likely due to Graff having initially designed the capacity of the channel for two engines of the Boulton and Watt type, not the more powerful Columbian Engine procured from Evans.[192]

Full testing and acceptance of Evans' engine was slow, partly due to problems with the boilers. The use of higher steam pressure was outpacing the capability of boilers at the time. Because of the difficulties, controversy arose between the Watering Committee and Evans over the engine's performance. Multiple tests were eventually performed in 1817. Consequently there

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[190] A hook spanner is a tool for turning certain kinds of fasteners. A spud wrench is a type of wrench with a blunt spike at the "opposite" end of the handle, used to line up bolt holes in pipe fittings, girder beams, or other assembly work.
[191] Watering Committee, *1816 Annual Report* (23 Jan 1817). On 2 Oct 1816 Evans was paid $330.84 for valve seats and castings.
[192] Watering Committee, *1816 Annual Report* (23 Jan 1817), 2.

are multiple sets of statistics on its performance.[193]

During the first contract trial the engine pumped 3,072,656 ale gallons up to Fairmount Reservoir in 24 hours, well below the minimum of 3,500,000 ale gallons specified in the contract. Fuel consumption was 13 cords of wood.[194] A second trial, performed in March by George Clymer and Jacob Perkins at Evans' request, demonstrated a 24-hour pumping capacity of 3,744,000 ale gallons.[195]

Frederic Graff, Jr., later reported that the engine was further tested on 15 May, during which time it pumped 3,666,021 U.S. gallons up to Fairmount Reservoir in 23½ hours. He also recorded that the engine filled the reservoir to a depth of 9 feet, 3 inches, burned 13 cords of oak wood, maintained between 194 and 200 lbs. of steam, and ran at 22 strokes per minute during the trial.[196]

Perhaps because of contention over the results of the previous tests, a final test was conducted by the Watering Committee on 26 and 27 Nov 1817. This trial confirmed that Evans had fulfilled the terms of his contract, validating a capacity of 3,556,401 gallons in 24 hours. During this test, the engine ran at 24¾ strokes per minute and consumed ten cords of oak in 20 hours.[197]

With the testing and acceptance of Evans' engine finally completed, it entered

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[193] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 246f.

[194] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 210ff, 214ff, 226f, 227f, 245ff. The Bathes' primary source was the reports of the Watering Committee to the Select and Common Councils of Philadelphia for the years 1814–20, 210n269. Oliver Evans, Water Department's historical report of 1860, 227.

[195] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 210ff, 214ff, 226f, 227f, 245ff. The Bathes' primary source was the reports of the Watering Committee to the Select and Common Councils of Philadelphia for the years 1814–20, 210n269. Oliver Evans, Water Department's historical report of 1860, 246.

[196] Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876), 6.

[197] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 247. *Aurora*, 25 Dec 1817.

operational service on 15 Dec 1817.[198] Custom-designed for Fairmount, it produced approximately 100 horsepower[199] and was the largest high-pressure steam engine built up to that time. The steam cylinder was 20 inches in diameter and featured a rotating steam valve actuated by the main shaft driving a bevel gear.[200] Sources differ on whether the stroke of the steam piston (and correspondingly the pump piston) was 48 inches or 60 inches.[201] It is possible that one dimension was planned but the other was actually built, or that one was initially built but modified to the other after installation and testing.

The engine's four cylindrical boilers, each 30 inches in diameter and 24 feet long, were housed in the Engine House's North Boiler Shed, the relatively narrow, one-story room on the north side of the building which matched the South Boiler Shed on the south side.[202]

To give an idea of the size and mass of this engine the following list made by Evans indicates the weights of selected cast iron components.[203]

Table 2-1. Weight of selected components of the North Engine.

Working cylinder	3,252 lbs.

[198] Watering Committee, *1817 Annual Report* (22 Jan 1818) 2; Watering Committee, *1852 Annual Report*, 6 Jan 1853, 27.
[199] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 210ff, 214ff, 226f, 227f, 245ff. The Bathes' primary source was the reports of the Watering Committee to the Select and Common Councils of Philadelphia for the years 1814–20, 210n269. Oliver Evans, Water Department's historical report of 1860, 212.
[200] Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876), 6.
[201] Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 15; *1852 Annual Report* (6 Jan 1853), 27; Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 241; Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876), 6. A length of 48 inches is given in both the 1852 AR and Bathe & Bathe. A length of five feet (60 inches) is given by Graff, Jr., in *Notes*.....
[202] Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 16; Watering Committee, *1852 Annual Report* (6 Jan 1853), 27; Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876), 6. As with the length of the piston stroke, there is some uncertainty regarding the dimensions of the boilers for the North Engine. The 1852 AR gives the dimensions shown above, but Graff, Jr., in *Notes…* gives the dimensions as 27 inches in diameter and 27 feet long.
[203] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 229.

Flywheel rim, (6 segments, 1,254 lbs. each)	7,524 lbs.
Flywheel radial arms, (6 radial arms, 620 lbs. each)	3,720 lbs.
Valve seat	1,602 lbs.
TOTAL	16,101 lbs.

Although the high-pressure North Engine proved it could pump approximately 3.5 million gallons up to the reservoir per day, Frederick Graff indicated in a letter to the chairman of the Watering Committee that only approximately 2.3 million gallons per day could be counted on with safe operation of the engine's boilers.[204] Graff's concern was not misplaced.

One of the problems with the early high-pressure steam engines was that metallurgical technology hadn't yet progressed to the point that boilers could be constructed which could operate safely at the higher temperatures and pressures required by the new machines. The cyclical expansion and contraction of the wrought-iron plates, combined with the different rates of expansion between cast and wrought iron, weakened the seams and joints, making it difficult to keep them steam-tight. If the water level was allowed to fall to the point that the fire box within was exposed, the plates tended to stretch and sag and split at the riveted seams.[205] Escaping steam sometimes extinguished the combustion in the fire box. Solutions were implemented by adjustment and experimentation. By the end of 1816, for example, the application of rust cement was used to improve the ability of the boiler to remain steam-tight.[206]

Evans himself recognized these dangers and took steps to mitigate them. He developed high-capacity pressure-release safety valves and, acknowledging that operators were likely to make onsite modifications and repairs without consulting the manufacturer, published the first

[204] Frederick Graff to Joseph S. Lewis, 4 Feb 1819.
[205] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 262.
[206] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 241.

set of formulae and recommendations for appropriate thicknesses and other specifications for wrought iron used in various boiler designs.[207] Safety valves manufactured by others, however, were sometimes too small to be effective. Too often, poor maintenance resulted in the safety valve becoming blocked by rust. In an effort to wring more power out of an engine, operators sometimes even wired the safety valve shut, with catastrophic results. Other safety measures like water level indicators were developed but again, poor maintenance often meant they were inaccurate or otherwise malfunctioning.[208]

Whether due to inferior materials, lack of metallurgical understanding, incompetence, or negligence, the result was often the same—super-heated steam, often mixed with wood or coal ash, bursting from the boiler at great velocity.[209] Boiler accidents were a constant threat.

This was no idle fear. In 1803, four workmen in Britain were killed when one of Trevithick's boilers exploded.[210] As high-pressure steam engines were adapted for water propulsion and steamboats proliferated on the waterways, boiler explosions caused an appalling loss of life. By the summer of 1817, five people had been killed in four explosions aboard steam-powered vessels navigating the waters of America's eastern seaboard and 25 had perished in three explosions on the Mississippi and Ohio Rivers.[211] The human toll would eventually climb much higher. During the first 25 years of steamboat operations on the western rivers, 130 boiler explosions occurred.[212] By 1848 the number had risen to 233 and more than 2,500 lives had been

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[207] Edwin T. Layton, Jr., ed., *Technology and Social Change in America* (New York: Harper & Row, 1973), 102.
[208] Edwin T. Layton, Jr., ed., *Technology and Social Change in America* (New York: Harper & Row, 1973), 103.
[209] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 262.
[210] Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900* (New York: Oxford University Press, 1967), 259.
[211] Edwin T. Layton, Jr., ed., *Technology and Social Change in America* (New York: Harper & Row, 1973), 103.
[212] Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900* (New York: Oxford University Press, 1967), 259.

lost.[213]

As early as 1817, with steamboats operating in and out of the wharfs on the Delaware River, the City Councils were concerned enough to appoint a panel of four experts, including Frederick Graff, to look into the causes of boiler accidents and determine what if any remedial measures might be appropriate.[214] The committee did not reach any conclusions as to causes, but did make a few recommendations along the lines of boiler certification testing and safety valve specifications. With the committee's report in hand, the City Councils decided that the issue was beyond the scope of its authority and forwarded all of the information and recommendations to the Pennsylvania state legislature with a request for further study and action. Unfortunately the state legislature ignored the City's request. Although nothing came of it once it landed at the state level, Philadelphia City Councils' action marked the first time in the United States that a legislative body of any kind had attempted to investigate the boiler explosion problem.[215]

The two steam engines at Fairmount were arranged side by side within the Engine House. They represented the two basic engine types of the time when the high pressure design was just

[213] Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: The Johns Hopkins University Press, 1974), 190.
[214] Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: The Johns Hopkins University Press, 1974), 172f. Sinclair states (172n5) that a description of the committee and its report was published in *Communications Received by the Committee of the Franklin Institute on the Explosion of Steam Boilers* (Philadelphia: The Franklin Institute, 1832) and that subsequently *Communications Received…* was itself published serially in the *Journal of the Franklin Institute,* Oct 1831—Feb 1832.
[215] Edwin R. Layton, Jr., ed., *Technology and Social Change in America* (New York: Harper & Row, 1973), 103f. The investigation would not be the last of Philadelphia's involvement in the issue. From 1830 to 1835, the United States Congress contracted with the Franklin Institute to perform a series of experimental tests. Using multiple purpose-built boilers, the work was methodical, thorough, and dangerous. Although the resulting report did not produce much in the way of effective legislation, the quantitative data gathered did help dispel misconceptions about boiler operations and resulted in the production and use of improved safety devices. It also marked two other important milestones—the first federally funded investigation in America and a significant change in the role of the federal government in the oversight and regulation of public safety, as well as the public's perception of it. See Edwin R. Layton, Jr., ed., *Technology and Social Change in America* (New York: Harper & Row, 1973), 107ff; Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: The Johns Hopkins University Press, 1974), 173ff, 188ff. The Franklin Institute's report was published serially in the *Journal of the Franklin Institute,* Jan–May 1836.

beginning to be utilized. Table 2-2 shows a comparison of selected performance attributes.[216]

Table 2-2. Comparison of Steam Pumping Engines Installed at the Fairmount Water Works, Philadelphia, April and September 1815.

	South Engine	North Engine
Cylinder diameter	44	20
Length of steam cylinder stroke	72	60
Length of pump cylinder stroke	72	48
Revolutions per minute	(not avail.)	24.75
Steam pressure (psi)	2.5	120–150
Horsepower	(not avail.)	100
Output in 24 hours (U.S. gallons)	2,115,031	3,666,021
Elevation of lift (feet above high tide)	98	98
Consumption of wood fuel per day (cords)	7	13
Duty (lbs water raised 1 ft with 94 lbs coal equivalent)	15,850,000	20,150,000
Cost of engines and boilers	$54,341	$23,000

The high-pressure North Engine produced by Oliver Evans pumped over twice the amount of water up to Fairmount Reservoir in a given time than the Boulton and Watt-type low-pressure South Engine while consuming less than twice the fuel while doing so. The North Engine was not only more powerful but also more efficient than the South Engine. Evans' engine was probably more reliable as well. Although there is evidence the South Engine was run from time to time,[217] industrialist and engineer George Escol Sellers later recalled in his memoir that

[216] Greville Bathe and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935), 210ff, 210n269, 214ff, 226f, 227f, 245ff. The Bathes' primary sources were the reports of the Watering Committee's Annual Reports for the years 1814 through 1820.

[217] *Lithograph by unknown artist,* summer 1822, Free Library of Philadelphia, accession 2005.021.0045, Philadelphia Water Department Historical Resource Archives. The lithograph depicts smoke emerging only from the south chimney, which exhausted combustion products from the boiler serving the low-pressure South Engine only. (The north chimney likewise exhausted combustion products from the boiler serving the high-pressure North Engine only.) This suggests that the low-pressure engine was not completely disused after it ceased to be the primary engine in 1817.

most of the time the North Engine was used.[218]

Table 2-3 is a comparison of the four steam engines the Watering Committee had procured and utilized up to this time, two at the Schuylkill and Centre Square Works and two at the Fairmount Water Works. The performance of Evans' engine certainly stands out from that of the other three.

Table 2-3. Comparison of Steam Engines Used in the Schuylkill and Centre Square Works (SCCW) and the Fairmount Water Works. *(Footnotes within table refer to citations at source table.)*

	SCCW Centre Sq. Engine	***SCCW Schuylkill Engine***	***FWW South Engine***	***FWW North Engine***
Start of Operation	27 Jan 1801[1]	22 Dec 1800[1]	7 Sep 1815[9]	15 Dec 1817[25]
End of Operation	7 Sep 1815[17]	7 Sep 1815[17]	14 Jan 1822[10]	14 Jan 1822[10]
Manufacturer	Nicholas Roosevelt, Soho Works[2]	Nicholas Roosevelt, Soho Works[2]	Samuel Richards, Eagle Works and Weymouth Foundry[10,24]	Oliver Evans,[10,24] Mars Works
Cost	$15,000[16]	$15,000[16]	$54,341[10,24]	$23,000[21]
Engine Type	low-pressure, atmospheric, Boulton & Watt[1]	low-pressure, atmospheric, Boulton & Watt[1]	low-pressure, atmospheric, Boulton & Watt[10]	high-pressure, "Columbian"[18,24]
Steam Pressure	2½ lbs/sq in[1]	2½ lbs/sq in[1]	2½–4 lbs/sq in[10,12,24]	194–220 lbs/sq in[10,15,22,24]
Cylinder Diameter	32 in[4]	38½ in[4]	43⅝ in[10,24]	20 in[10,24]
Cylinder Stroke	6 ft[4]	6 ft[4]	6 ft[10,24]	4 or 5 ft[10,24]
Pump Type	double-acting[4]	double-acting[4]	double-acting[10]	double-acting[13]
Pump Diameter	18 in[4]	17½ in[4]	20 in[20,24]	20 in[24]
Pump Stroke	6 ft[4]	6 ft[4]	6 ft[20,24]	4 or 5 ft?[10,24]
Water Lift	51 ft[4]	39 ft[1]	102 ft[10]	102 ft[10]
US Gallons Raised In 24 Hours	1,161,745[1,5]	1,798,890[1,5]	2,115,031[10]	3,666,021[13,24]
Fuel Consumption Per Day	55 bushels Virginia coal[1]	70 bushels Virginia coal[1]	7 cords oak wood[10] (or 148 bushels Virginia coal[26])	13 cords oak wood[13,24]
Calculated Duty (lbs water raised 1 ft per 100 lbs coal)	4,091,000[1]	4,790,000[1]	15,850,000[23]	20,150,000[23]

[218] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–1840) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 38.

Lever Beam Length	(not avail.)	(not avail.)	23 ft, 9 in[10,11,24]	(not avail.)
Lever Beam Material	wood[4]	wood[4]	cast iron[24]	wood[13,14,24]
Flywheel Rim Material	wood[4]	wood[4]	wood[10]	(not avail.)
Flywheel Arms Material	wood[4]	wood[4]	cast iron[24]	(not avail.)
Flywheel Shaft Material	wood[4]	wood[4]	cast iron[24]	(not avail.)
Flywheel RPM	16[6]	16[1]	(not avail.)	22[13,24]–34¾[22]
Boiler Material	wood, with iron fire box and flues[8]	wood, with iron fire box and flues[7]	cast iron[24]	wrought iron[13,24]

When the Fairmount Water Works began operations on 7 Sep 1815, the Fairmount Reservoir consisted of a single basin with a capacity of 3,264,126 ale gallons, approximately a four-day supply at the time. This initial basin covered a little less than 1¼ acres; it was rectangular and divided into two cells.[219]

In order to elevate the water to a level as high as possible, the reservoir atop Fairmount was not excavated into the rock but its surrounding wall was instead built atop the natural grade, using the bedrock as a foundation.[220] The 40-foot-high wall was constructed of stone and was grouted and covered with two inches of mortar to prevent leakage. The inner surface of the basin consisted of a base layer of clay which was paved with bricks and lime mortar. The brick construction was sealed with a top layer of grout.[221] The basin was approximately twelve feet deep and was partitioned, down the middle, into two cells to allow for cleaning, repairs, or maintenance without the need for draining the entire reservoir and shutting down the system. An example of Graff's foresight, the stone partition was also intended to serve as the base for

[219] Frederick Graff to Joseph S. Lewis, 22 Dec 1817. Philadelphia Water Department Historical Archives.
[220] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 24.
[221] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 24.

supports of a roof should one someday be desired, though one was never built.[222]

Around the outside of the reservoir's embankment a belt of clay approximately two feet thick was laid and the remaining area was backfilled with loam to bring the grade up to the level of the top of the wall. The soil was seeded with grass to prevent erosion. Eventually a walkway would be constructed around the reservoir.[223]

There was additional unused space atop Fairmount which afforded Graff the ability to expand the reservoir as demand for water increased. By 1818, in fact, Graff had already enlarged it for the first time, by approximately 500,000 gallons.[224]

After the second steam engine began operating, the Fairmount Reservoir received water from either of the two engines via a common 16-inch iron ascending main. After penetrating the eastern wall of the Engine House below ground, the main passed under Ferry Road (which was later replaced by walkways and plantings), and then ascended to the reservoir within a small ravine carved out of the rock face.[225]

The steam engines pumped raw river water up to the reservoir. Because the water remained in the reservoir for at least a day before entering the distribution system, however, some settling out of solid matter occurred. This process, called sedimentation at the time, served to clarify the water to some degree.

From the Fairmount Reservoir, the water flowed by gravity to the iron distribution chest below ground on the east side of the now-shuttered Centre Square Engine House.[226] As the crow flies, this was a distance of approximately 1¼ miles, but because of the necessity of following

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[222] Watering Committee, *1813 Annual Report* (11 Nov 1813), 4.
[223] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 24f.
[224] J. Walker to Messrs. Glennie and Son, 2 Aug 1819. Philadelphia Water Department Historical Archives.
[225] A small portion of this part of the ascending main may still be seen at the top of the cliffside today.
[226] Watering Committee, *1815 Annual Report* (25 Jan 1816), 4; John A. Paxton, *The City of Philadelphia for the Use of Firemen and Others,* map (Philadelphia: 1817).

the perpendicular city streets, the actual distance was approximately 1.8 miles. Frederick Graff originally wanted to install a single 14-inch cast iron main, but because of the cost of importing iron pipe from Britain, fears that the segments of pipe would not be delivered by the British supplier soon enough, and uncertainty regarding the performance of iron for mains, wood mains were installed instead.[227] Graff's alternative was to use a set of five parallel wood mains consisting of logs bored out to an interior diameter of six inches, but even this plan had to be trimmed due to difficulty in obtaining enough timber of sufficient size. Graff was forced instead to employ only four six-inch mains and one main bored out to 4½ inches.[228] He did manage, however, to add an additional six-inch wood main by the end of 1817.[229] From the distribution chest, the water flowed through the underground distribution system that the Fairmount Works inherited from its predecessor. This consisting of spruce and yellow pine logs bored out to an interior diameter of between four and six inches. This system grew to over 32 linear miles by 1817.

The new system was now functioning reasonably well, certainly better than the Schuylkill and Centre Square Works had. One or other of the Fairmount Water Works' steam engines—usually the high-pressure North Engine—was always operating, the Fairmount Reservoir was kept full, and plentiful water was flowing through the distribution system.

This happy situation, however, would not last. Two developments combined to greatly increase the demand for water. The first was the end, in 1815, of the War of 1812. The resulting resumption of foreign trade meant an increase in commercial activity. This served to stimulate continued population growth. Philadelphia's population had grown from 41,220 in 1800 to

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[227] Frederick Graff to Joseph S. Lewis, 28 Oct 1818, published in Watering Committee, *1818 Annual Report* (12 Nov 1818), 6.
[228] Watering Committee, *1815 Annual Report* (25 Jan 1816), 3.
[229] Frederick Graff to Joseph S. Lewis, 22 Dec 1817. Philadelphia Water Department Historical Archives.

53,722 in 1810. By 1820 the population of the settled area of Philadelphia and the surrounding districts was nearly 110,000.[230] There was a steady increase in the number of residential, commercial, and institutional structures supplied with water, up from 2,396 in 1812 to 2,983 in 1815,[231] a 24 percent increase in three years. This growth increased the demand for water.

The second development magnified the heightened demand. It is an example of what is today recognized as the principle of rising expectations. Then as now, customer satisfaction was a moving target. Once water had become readily available and its advantages realized, residents and businesses alike wanted even more. When clean water began to be available in homes, people began to use water to cook with more than when water was less clean and abundant. People increasingly used water for hygienic purposes as well. Although residents paid an added charge of $3 for private baths,[232] such in-home conveniences increased from 172 in 1813 to 228 in 1815. This shift in public perception and behavior began to occur in 1801 with the initial improvement provided by the Schuylkill and Centre Square works and continued unabated through the first years of operations at Fairmount. The demand for additional water would only increase.

It was soon apparent, however, that the full benefit of the new pumping station and reservoir at Fairmount would not be realized unless a better distribution system could be devised. The flow of water was slowed considerably by friction with the wood material of the mains.[233] The small interior dimensions magnified the problem. Right-angle connections at every street

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[230] U.S. Census Bureau, *Population of the 61 Urban Places: 1820,* <https://www.census.gov/population/www/documentation/twps0027/tab05.txt>, 15 Jun 1998, accessed 31 Jan 2019. Includes Spring Garden and Kensington neighborhoods.
[231] Watering Committee, *1815 Annual Report* (25 Jan 1816), 5.
[232] The equivalent of approximately $58 in 2022.
[233] Watering Committee, *1815 Annual Report* (25 Jan 1816), 4.

corner and intersection created turbulence, further impeding the flow.[234] The wood mains were also prone to leakage and bursting.[235] In an attempt to reduce leakage at joints, wrought iron bands were wrapped around the ends of the log pipes while hot. As the iron cooled it contracted, tightening the joints.[236]

The combination of increased demand and a defective distribution system caused a water shortage in the summer of 1818. Even though Fairmount's engines kept the reservoir full, it was estimated that only one million gallons in 24 hours was able to be distributed throughout the city, meeting less than half of the demand.[237] Graff had already been considering the benefits of cast iron pipe. He had obtained sample pipe segments from England in 1817[238] and had been corresponding with a London engineer, a Mr. J. Walker. Walker supplied Graff with a great wealth of information, drawn from experience, regarding the benefits and practical use of cast iron. On 28 Oct 1818, Graff submitted a detailed report to the Watering Committee in which he recommended the adoption of cast iron pipes.[239] Joseph S. Lewis, chairman of the Committee at this time,[240] rolled up Graff's recommendation and other reports with Walker's correspondence and submitted it to Councils on 11 Nov 1818.[241] Councils gave the go-ahead for initial procurement on 26 Jan 1819.[242]

Although the city was able to keep the Fairmount Reservoir filled by using one of the two

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[234] Frederick Graff to Joseph S. Lewis, 22 Dec 1817; Frederick Graff to Joseph S. Lewis, 28 Oct 1818, published in Watering Committee, *1818 Annual Report* (12 Nov 1818), Philadelphia Water Department Historical Archives. See also Watering Committee, *1815 Annual Report* (25 Jan 1816), 4.
[235] Frederick Graff to Joseph S. Lewis, 14 Jul 1819. City of Philadelphia Archives.
[236] Watering Committee, *1802 Annual Report* (1802), 7. The bands were made by the Eagle Works for $80 a ton. The foundry was operated as late as 1810 by Samuel Foxall; by 1812 Samuel Richards was the operator.
[237] Watering Committee, *1818 Annual Report* (12 Nov 1818), 3f.
[238] Watering Committee, *1818 Annual Report* (12 Nov 1818), 4.
[239] Frederick Graff to Joseph S. Lewis, 28 Oct 1818, published in Watering Committee, *1818 Annual Report* (12 Nov 1818), 6ff.
[240] Lewis (9 May 1778–13 Mar 1836) was appointed chairman of the Watering Committee in 1817 and would serve until 1825.
[241] Watering Committee, *1818 Annual Report* (12 Nov 1818).
[242] Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.

engines, costs were high. As Table 2-4 shows, Graff estimated in 1819 that the annual expense of operating and maintaining either engine pumping 2,300,000 gallons daily was $30,858.[243]

Table 2-4. Annual operating cost of Fairmount Water Works, 1819.

Six-man team to operate and maintain the engine (@ $9.75 per day)	$3,558.75
Tallow, oil, chandlery, etc.	1,250.00
Fuel (3,650 cords of wood and shanking, @ $7.00 per cord[244])	24,550.00
Repair of wear and tear of machinery	1,500.00
TOTAL	$30,858.75

This was far from the estimate made in Davis and Graff's 1811 report to the Watering Committee in which they had projected a total capital cost of $148,939 and annual operating cost of $8,360. It was over three and a half times higher in fact. And this didn't even include the annual interest on the loan required to fund the up-front capital expenditure for construction of the system.[245] Of course, operational realities are often much different than prior planning estimates and costs are influenced by factors which are difficult to predict years in advance. Nonetheless, the costs were shockingly high and demand was rising. If more water was desired, Graff said an additional main could be constructed from the Engine House up to the reservoir, so that both engines could pump at the same time, but then the annual operating expense would be approximately doubled,[246] hardly an attractive proposition.

The largest single component of the operating expense was the cost of fuel. Just shy of 80

[243] Frederick Graff to Joseph S. Lewis, 4 Feb 1819. Included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 7f. The amount was the equivalent of approximately $719,600 in 2022.
[244] The eagle-eyed reader will note that at $7.00 per cord, 3,650 cord of wood would cost $25,550.00, making the total annual cost $31,858.75. The mathematical error is original to the *Report*.
[245] Morris A. Pierce, "Report of Messrs. Davis and Graff to the Watering Committee of Philadelphia, 18 Dec 1811" *Documentary History of American Water Works* (Department of History, University of Rochester, updated 12 Jul 2018), <http://www.waterworkshistory.us/PA/Philadelphia/1811Report.htm>, accessed 4 Aug 2018.
[246] Frederick Graff to Joseph S. Lewis, 4 Feb 1819. Included in *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: Lydia R. Bailey), 8.

percent of the total, it was far greater than the cost of labor, the next highest element. The North Engine, despite its advantage in power and efficiency, still consumed fuel at nearly twice the South Engine's rate. In order to accommodate its appetite, the wood storage area on the south side of the Engine House had to be enlarged, requiring excavation into the side of Fairmount itself. The work was started in 1816 and took two years to complete.[247] Such was the combined voracity of the engines at Fairmount.

The supply of water needed to be increased to meet rising demand but, for the time being at least, steam power at the Fairmount Water Works was not up to the task.

[247] Watering Committee, *1816 Annual Report* (23 Jan 1817), 2; Watering Committee, *1817 Annual Report* (22 Jan 1818), 2; and Watering Committee, *1818 Annual Report* (14 Jan 1819), 2.

CHAPTER 3

WATER POWER AT FAIRMOUNT

It was now 1818 and the City of Philadelphia needed more water, it was as simple as that. Population increase, economic growth, and a shift in public perception and behavior all contributed to a greater demand for water. While the steam engines of the Fairmount Water Works, and the Schuylkill and Centre Square Works before it, had been groundbreaking and had supplied water to the city for nearly 18 years altogether by now, they were expensive to operate and were unreliable, dangerous, or both. The system couldn't be expanded to meet rising demand without incurring unacceptably high operating costs. The Watering Committee again found itself seeking a more suitable alternative.

Although the Committee had investigated the possibility of using water power when it sought a replacement for the Schuylkill and Centre Square Works in 1811, the Union Canal Company had held the water rights along the Schuylkill River. The Union Canal Company would never have allowed the use of water power at Fairmount because the necessary dam would've flooded their proposed canal. Water drawn from the river by steam power was compatible, however, with the design of the canal at that time.

There was also lingering suspicion that water power was too unreliable, at least on the Schuylkill River. Too much water during flood events or too little water in winter and during dry spells, the thinking went, would cause the works to be shut down, perhaps during an emergency like a fire when water was needed most. Years of experience with the steam engines of the day, however, had provided reason enough for taking a new look at water power.

In a later report of the Watering Committee, Chairman Joseph S. Lewis would in

hindsight remark:

> The constant and great expense attending the Steam Engine, and the vexation occasioned by repeated accidents, have always been present to the Watering Committee, who have ever thought water power should be resorted to if practicable.[1]

As it happened, just as water power was becoming more attractive compared to steam, numerous factors were converging to make it practicable.

Commercial and residential development in America at this time was still largely confined to a relatively narrow strip along the Atlantic coast and transport of goods and materials was almost entirely by natural waterways. With the blockading of foreign commerce during the War of 1812, however, inland navigation rose in importance. Development of the interior needed to be encouraged and Philadelphia needed to be connected to it. One of the challenges was to make the Schuylkill River navigable from the mouth of the river in Philadelphia to Schuylkill County above Reading.

Recall that by 1802 the Delaware and Schuylkill Canal Company had foundered and its charter had expired. That company had the sole authority to construct a canal along the east shore of the Schuylkill River upstream of Philadelphia, continue the canal from the Schuylkill River to the Delaware River along the northern boundary of the City, and draw water from the Schuylkill River to fill the canal. In 1811 the state legislature had chartered the Union Canal Company and gave it the sole right to construct a canal along either side of the Schuylkill River, allowing the City of Philadelphia to draw water from the east side while the canal company reserved for itself the west side. This is what the Watering Committee did when it constructed the steam-powered operation at Fairmount from 1812 to 1815.

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[1] Watering Committee, *1818 Annual Report* (5 Feb 1819), 3; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).

Just as the Fairmount Water Works began operating with steam power, however, the Union Canal Company abandoned its rights on the Schuylkill River south of Reading, as well as the idea of building a canal between the Schuylkill and Delaware Rivers, and concentrate on building a canal between the Schuylkill River at Reading and the Susquehanna River at Middletown (just south of Harrisburg).[2] There remained demand for transportation improvement along the Schuylkill River, however, and in 1815 the Pennsylvania legislature chartered the Schuylkill Navigation Company for the purpose of constructing a canal from Philadelphia to Reading and points north.[3]

The final piece of the puzzle was that the water rights of the Schuylkill River at the Falls of the Schuylkill, six miles upstream from Fairmount, had become available.

Constructing a canal was a capital-intensive endeavor. It required the raising of a lot of money up front, before any profit could be realized by the actual operating of the canal. The managers of the Schuylkill Navigation Company realized they could save on capital costs in two ways.

First, instead of the continuous canal which the Union Canal Company (and the Delaware and Schuylkill Canal Company before that) intended to build, the Schuylkill Navigation Company designed a lock-and-slackwater canal system made up of a series of dams, ponds, locks, and short sections of canal, depending on the topography of any given point along the river.[4] A slackwater system would not require as much canal infrastructure.

Next, if the company could induce others to build some of the dams and locks in

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[2] Even this focused goal the company found difficult to achieve. The Union Canal between the Susquehanna and Schuylkill Rivers was begun in 1792 by the Union Canal Company's predecessor, the Schuylkill and Susquehanna Canal Company, and would not be completed until 1828.
[3] *Laws of Pennsylvania, 1814–1815,* 72.
[4] This is the reason the system was called the Schuylkill *Navigation* system, not the "Schuylkill Canal."

exchange for the rights to develop water power for mills or factories at those sites, capital costs would be reduced even more.[5]

In the end, a businessman named Josiah White was the only one to take advantage of the opportunity offered by the canal company.[6] An enterprising merchant, White (Mar 1781–14 Nov 1850)[7] was in fact one of the founders of the Schuylkill Navigation Company but had left the company when the other investors and managers wouldn't pursue the canal's planning and construction as aggressively as he thought was necessary.

White had developed a successful hardware business and sold it by the age of 27. With the proceeds of the sale, he built a country house for himself at the Falls of the Schuylkill (at present day East Falls). Not one to sit on his hands, in 1810 he purchased the right to build a water-powered mill at the Falls from the previous owner of the land, one Robert Kennedy,[8] and soon built a foundry, as well as a mill for manufacturing wire and nails. In 1809 White had even built one of the earliest known wire suspension bridges, a 400-foot-long footbridge across the Schuylkill nearby, replacing a succession of earlier chain bridges which had each collapsed.[9]

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[5] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 120. Powell cites Schuylkill Navigation Company, *Minutes of the Managers, Book A*, 8 Feb, 12 Mar, 4, 16, and 29 May, 27 Jul, 30 Oct, and 18 Dec 1816, MC 110, PHMC; and Schuylkill Navigation Company, *Address of the President and Managers of the Schuylkill Navigation Company to the Stockholders and to the Public in General* (1817).
[6] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 120. Powell cites Schuylkill Navigation Company, *Minutes of the Managers, Book A*, 8 Feb, 4 and 8 May, 21 Aug, and 18 Sep 1816, MC 110, PHMC; and Schuylkill Navigation Company, *Address of the President and Managers of the Schuylkill Navigation Company to the Stockholders and to the Public in General* (1817).
[7] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 956ff; Charles V. Hagner, *Early History of the Falls of Schuylkill, Manayunk, Schuylkill and Lehigh Navigation Companies, Fairmount Waterworks, Etc.* (Philadelphia: Claxton, Remsen and Haffelfinger, 1969), 41ff, <https://archive.org/details/earlyhistoryoffa00hagn/page/40>, accessed 17 Jun 2019; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 232, 235ff, 238f.
[8] Watering Committee, *Report of the Watering Committee of the Agreements with the Schuylkill Navigation Company and White and Gillingham Relating to the Water Power of the River Schuylkill* (Philadelphia: 1819), 27; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).
[9] Francis E. Griggs, Jr., "Louis Wernwag and the Colossus of 1812," *Practice Periodical on Structural Design and Construction*, Vol. 15, Issue 3 (Aug 2010); Francis E. Griggs, Jr., "The Colossus of the Schuylkill River," *Structure* (Jun 2014), <www.structuremag.org/?p=2622>, accessed 12 Aug 2019.

In America and Europe at this time, the coal used in iron production and other early industries was bituminous coal, from Virginia and Britain. Anthracite coal, found in abundance in eastern and northeastern Pennsylvania, was harder, higher in carbon content, lower in sulfur and other impurities, and released more thermal energy, but it was very difficult to get to burn. No one had yet found a way to work with it effectively. When the Watering Committee took delivery of a quantity of anthracite from Lehigh County in 1806, recall, attempts to use it to fire the boilers of the steam engines in the Schuylkill and Centre Square Works failed and it ended up being treated like common gravel and spread on a walkway.[10]

White had been one of the entrepreneurs experimenting with anthracite. He had been using bituminous coal in his foundry but was convinced anthracite would be a better alternative. He and his men spent a great deal of time, money, and effort trying to find a way to use it but without success. In 1815, as the story is told,[11] the men at his foundry grew so frustrated that in disgust one evening they simply threw a large quantity of the anthracite into the furnace as they left the shop. When one of the workers returned a little while later to retrieve a jacket he had left behind, he discovered the furnace red hot with the heat of the burning coal. The team was called back to the mill and they processed three runs of iron powered by the coal in the furnace.

White immediately began experimenting with grates of various designs in order to make anthracite commercially viable for industrial and residential use. The same year he helped create the Schuylkill Navigation Company in 1815 to bring anthracite to the Philadelphia market. When White left the company in 1818, he started the Lehigh Coal and Navigation Company to do the same via the Lehigh and Delaware Rivers instead of the Schuylkill.

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[10] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 89.
[11] Charles V. Hagner, *Early History of the Falls of Schuylkill, Manayunk, Schuylkill and Lehigh Navigation Companies, Fairmount Waterworks, Etc.* (Philadelphia: Claxton, Remsen and Haffelfinger, 1969), 42ff.

Leaving the Schuylkill Navigation Company didn't prevent White from doing business with it. On 14 Aug 1816 he and partner Joseph Gillingham had signed an agreement with the company to build a dam and locks at the Falls of the Schuylkill which would create a slackwater pond up to the intended site of the canal company's Flat Rock Dam, approximately a mile upstream. In exchange he would have the right to use all of the water power where he built the dam.[12] In other words, for the cost of constructing a dam and locks for the canal company, White would have a far greater amount of water power to use, sell, or lease than he would have otherwise. This was shrewd in itself, but White was no fool for another reason as well. By building the dam and locks himself, he would not be at the mercy of someone else who might come along to take advantage of the opportunity the Schuylkill Navigation Company was offering.

While he was constructing the dam, White thought perhaps he could entice the City of Philadelphia to purchase from him some of the water his dam would impound. White and Gillingham proposed to supply to the Fairmount Reservoir up to two million gallons of water a day for $25,000 per year[13] for twenty years, then $3,000 per year[14] thereafter in perpetuity. A Committee of Rush, Miller, and Moore investigated, but by November 1817 the discussion ended.

White stated in a later memoir:

> [We] had made the strongest efforts in our power to deal with Philadelphia, to supply their Fair Mount Water. ! we offered to City Councils to provide them with water from

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[12] Watering Committee, *Report of the Watering Committee of the Agreements with the Schuylkill Navigation Company and White and Gillingham Relating to the Water Power of the River Schuylkill* (Philadelphia: 1819), 27; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820). See also Watering Committee, *Report of the Watering Committee on the Propriety oif Raising the Dam at Fairmount* (Philadelphia: 1820), 4.

[13] The equivalent of approximately $556,700 in 2022.

[14] The equivalent of approximately $66,800 in 2022.

> Fairmount, supplying 3,000,000 gallons of water every 24 hours for 20 years for $25,000 a year & then 3,000,000 Gal every 24 hours at $3,000 a year for ever. Provided they would issue City Certificats [*sic*] to make the [improvement] on [account] of this Annuity & also they to give us their Engines & fixtures at fair Mount & all the City property there & shore below the bridge so that we should have Room to use our Surplus Water, below this dam. By this Surpluss [*sic*] water we expected to make our Estate whole ...[15]

Rebuffed by the Watering Committee, White appealed to the court of public opinion, publishing in a local newspaper comments on the high price the city had paid for its earlier steam operations as compared with the much lower estimated cost of his proposed system.[16] Neither the Watering Committee nor Councils, however, took the bait.

It is likely White's entreaties went nowhere with the City of Philadelphia because his proposal had already sparked among members of the Watering Committee the realization that an ideal opportunity was presenting itself. The committee members were all prominent businessmen of various sorts, highly involved in the affairs of the city and very well informed because of it; they were doubtless already well aware of the circumstance which was developing. They would certainly have been aware of it, in any event, after White's proposal brought it to their attention.[17]

The opportunity was this: if a dam and locks were constructed high enough at Fairmount, it would create a slackwater pond to just beyond the Falls of the Schuylkill, a distance of

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[15] Josiah White, *Josiah White's History Given by Himself,* (The Lehigh Coal & Navigation Company, reprinted by Carbon County Board of Commissioners, 29 Jun 1979), 16f.
[16] *Aurora, 5* Aug 1818.
[17] Joseph S. Lewis said as much in Watering Committee, "Report of the Watering Committee" (5 Feb 1819), included in *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 4. "The present Committee have been fully alive to the importance of the subject; and their desire of accomplishing it more and more excited, by the success of the improvement of the Schuylkill by Dams and Locks [the Schuylkill Navigation system], which suggested the practicability of erecting a Dam and Water Works near Fair Mount."

approximately six miles upstream, replacing White's dam at the Falls and allowing the Watering Committee to use water power at Fairmount while satisfying the Schuylkill Navigation Company's aims for that portion of the river. Of course, the City of Philadelphia would need to purchase the water rights at the Falls of the Schuylkill from White and Gillingham, but if the partners could be persuaded to sell their rights, it would be a win-win-win situation for all three parties.

Watering Committee chairman Joseph S. Lewis saw the opportunity clearly. A wealthy Philadelphia merchant and a director of two prominent banks, Lewis (9 May 1778–13 Mar 1836)[18] had played an active part in promoting the Fairmount project in 1813,[19] even before he became chairman of the Watering Committee.[20] Lewis would serve as chairman of that body from 1817 to 1825 and from thereafter until his death as the second president of the Schuylkill Navigation Company. In addition to his work in Philadelphia he consulted on the water supply systems of other cities, including New York and Boston.[21]

Shortly after hearing White's proposal, he made a research trip in late 1817 during the early winter to Thomas Gilpin's mills on the Brandywine Creek in northern Delaware, roughly 30 miles southwest of Fairmount, to investigate the way water power was being successfully applied there.[22]

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[18] From Lewis' memorial, published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 479.
[19] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 102.
[20] Lewis served as chairman of the Watering Committee from 1817 to 1825.
[21] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 42, 109f, 172ff; Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 477f.
[22] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: Historical Society of Pennsylvania, 1913), 471.

The son of a successful Quaker mill operator and scientific inquirer,[23] Thomas Gilpin (1776–1853)[24] and his brother Joshua had built a paper mill on the Brandywine Creek in 1787 and a wool mill in 1812. A lifelong bachelor and member of the American Philosophical Society,[25] Thomas was the inventive force behind the successful operation. He pioneered machine-made paper in America and patented three paper-making devices, including the endless paper machine which used a wire-covered cylinder revolving in a vat of rag pulp.[26] At around the time of Lewis' visited, the Gilpins employed sixty workers.[27]

There were many other water-powered mills around the region, especially across the northern and western environs of the Philadelphia area where streams crossed the fall line. Gilpin, however, was achieving impressive results with a difference in water level of only seven feet and he was doing it with an innovation on the water wheel called the breast wheel. Since the seven-foot drop was comparable to that which would be created by a dam at Fairmount, Lewis decided Gilpin's operation was clearly something he needed to observe.

One of the most significant technological developments of human civilization, the vertical water wheel has been used to power mechanical operations of various sorts since shortly before the time of Christ.[28] For centuries, two basic types were employed, overshot wheels and

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[23] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 389ff.

[24] Harold B. Hancock and Norman B. Wilkinson, "The Gilpins and Their Endless Papermaking Machine," *The Pennsylvania Magazine of History and Biography,* Vol. 81, No. 4 (Philadelphia: University of Pennsylvania Press, Oct 1957), 391ff.

[25] Harold B. Hancock and Norman B. Wilkinson, "The Gilpins and Their Endless Papermaking Machine," *The Pennsylvania Magazine of History and Biography,* Vol. 81, No. 4 (Philadelphia: University of Pennsylvania Press, Oct 1957), 392.

[26] Harold B. Hancock and Norman B. Wilkinson, "The Gilpins and Their Endless Papermaking Machine," *The Pennsylvania Magazine of History and Biography,* Vol. 81, No. 4 (Philadelphia: University of Pennsylvania Press, Oct 1957), 393.

[27] Harold B. Hancock and Norman B. Wilkinson, "The Gilpins and Their Endless Papermaking Machine," *The Pennsylvania Magazine of History and Biography,* Vol. 81, No. 4 (Philadelphia: University of Pennsylvania Press, Oct 1957), 492.

[28] Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore: Johns Hopkins University Press, 1983), 1, 4.

undershot wheels. By the mid-1600s a new type of water wheel, the breast wheel, began to be used. The difference between the breast wheel and the overshot or undershot wheel is the point at which the water impinges upon the wheel. In the undershot wheel, water flowing from a channel (a head race) drives the wheel from the bottom; in the overshot, the water drives the wheel from the top. The water impinges upon the breast wheel, however, at a point in between, usually a little below the level of the wheel's axis.

The motive force for undershot wheels is entirely from the impulse of the water, the force of the water striking the blades of the wheel. Overshot wheels benefit somewhat from the weight of the water, but like undershot wheels are driven mostly by the water's impulse. Breast wheels, however, are driven entirely by the weight of the water. Overshot wheels are more efficient than undershot wheels, but breast wheels are more efficient than both. This is because the weight of the water is more significant as a motive force than the impulse of the water striking the blades. One of the keys to the breast wheel's efficiency is the fitted casing, or breast, around the lower part of the wheel. This keeps the water on the blades of the wheel (or buckets in many cases) and allows it to benefit from the full weight of the water. Another feature contributing to its efficiency is that the wheel moves in the same direction of the water where it exits the wheel.

The breast wheel was rarely used, however, until the 1750s when the legendary British engineer John Smeaton (1724–1792) validated its superiority using quantitative experimental analysis with model wheels. Smeaton also refined the design of the breast wheel, further increasing its effectiveness. He demonstrated a doubling of efficiency versus that of the undershot wheel.[29]

Gilpin discovered that a British millwright named Thomas Oakes (†1823) had come to

[29] Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore: Johns Hopkins University Press, 1983), 223ff, 278ff.

America and settled in New Jersey.[30] Oakes had worked with Smeaton in Britain. Well-experienced in applying Smeaton's principles, he would analyze the hydraulics of a given site and tailor a water power design suited to it. Gilpin and his brother hired Oakes to convert their paper mill to breast wheels in 1808. The new design was so successful that eight years later Gilpin had Oakes convert his wool mill and other mills to breast wheels as well.[31]

Having read up on Smeaton's published work, Lewis was familiar with the design of Gilpin's breast wheels before he visited the Brandywine site.[32] In short, Lewis did his homework. He knew the value of the breast wheel was seen most clearly where the head (the difference in elevation between the upstream and downstream water levels) was relatively small, as it was both at Gilpin's mills on the Brandywine and on the Schuylkill at Fairmount.

Lewis was so impressed with how Gilpin was utilizing water power that with Gilpin's encouragement he arranged for Frederick Graff and two members of the Watering Committee to see the operation for themselves.[33] In an indication of the imperative that Lewis felt, the group's visit took place the day after the arrangements were finalized.[34] The four men spent all day observing the operation and investigating the efficiency and effectiveness of the breast wheels. They were especially keen to evaluate one particular aspect, the pumping of water. The production of paper required a great deal of water and one of the breast wheels drove a water pump. They were impressed with the "iron forceing [*sic*] pump which had been in constant

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[30] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 473. Oakes was living in Bloomington, near Paterson.
[31] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 473.
[32] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 472.
[33] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 474.
[34] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 474.

operation night and day thro' all the year, and raised more than 200,000 gallons of water per day, for the six Paper engines, and the Paper machine…"[35] The experience of Gilpin at Brandywine was scalable to the needs at Fairmount and was highly encouraging. By the time they were finished with their investigations, the men had determined that something similar should be employed at home.[36]

Gilpin recommended to Lewis that if the City of Philadelphia did manage to use water power at Fairmount, it should employ Thomas Oakes to design the system.[37]

In October of 1818, a little over two years after White had agreed to construct a dam at the Falls of the Schuylkill for the Schuylkill Navigation Company, the company determined that the structure he was building did not meet its specifications.[38] By 1819, difficulties in constructing the dam and changes in his commercial interests made White amenable to selling his water rights to the City. He had become interested in developing the Lehigh Valley anthracite coal fields and building the Lehigh Canal on the Lehigh River. His business arrangements in East Falls were no longer profitable and he needed funds for his new ventures.

When the Watering Committee learned that White was willing to sell his interests at the Falls of the Schuylkill, it acted immediately. As advantageous as water power at Fairmount seemed to be, before committing the City of Philadelphia to constructing a water-powered system at Fairmount, the committee needed to be as certain as possible that it was both feasible and affordable. In other words, did the hydraulic characteristics of the Schuylkill River at

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[35] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 474.
[36] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 474.
[37] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37, No. 4 (Philadelphia: Historical Society of Pennsylvania, 1913), 474f.
[38] H. Benjamin Powell, *Coal, Philadelphia, and the Schuylkill* (Lehigh University, 1969), 124. Powell cites Schuylkill Navigation Company, *Minutes of the Managers, Book A,* 29 Apr, 2 May, 25 Jul, 17 Aug, and 21 Oct 1818, MC 110, PHMC.

Fairmount truly provide enough water to operate a canal lock and power a pumping station to move enough water up to the Fairmount Reservoir to keep it filled? Did the physical features of the Schuylkill River at Fairmount allow for the construction of a dam and other necessary water power components? If so, could the system be built in a cost-effective manner?

Prior to approaching Josiah White, the Watering Committee invited several prominent engineers and builder-contractors to study the Schuylkill River at Fairmount and submit construction proposals and cost estimates if they determined water power was feasible. Those consulted were Thomas Oakes, Ariel Cooley, Lewis Wernwag, and the partners William Briggs and William Lehman.[39] Cooley had served as Chief Engineer for the Schuylkill Navigation Company since January 1817[40] and was just finishing building a dam on the Schuylkill River at Flat Rock for the Schuylkill Navigation Company. Wernwag had in 1815 completed the landmark Upper Ferry Bridge which replaced the ferry operation across the Schuylkill River just downstream of Fairmount. William Briggs was Josiah White's stonemason.[41] William Lehman, a Philadelphia wholesale druggist and Federalist serving in the Pennsylvania General Assembly's House of Representatives, was a strong advocate for publicly funded infrastructure improvements.[42]

At Lewis' request, Ariel Cooley had sounded the river and reported that it was possible to

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[39] Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).
[40] Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 21.
[41] Christopher T. Baer, *General Chronology of the Pennsylvania Railroad Company, 1815–1819* (May 2015), 67; "Josiah White's Kind, Conquering Nature Tames the Lehigh River Valley," *Cultured Carbon County* (10 Feb 2011), <https://culturedcarboncounty.blogspot.com/2011/02/josiah-whites-kind-conquering-nature.html>, accessed 31 Aug 2022.
[42] William Lehman, *Report of the Committee on Roads and Inland Navigation, William Lehman, Chairman* (Harrisburg: Pennsylvania General Assembly, House of Representatives, 11 Mar 1818), 3ff; Douglas E. Bowers, "From Caucus to Convention in Pennsylvania Politics, 1790–1830," *Pennsylvania History,* Vol. 56, No. 4 (Oct 1989), 294; Christopher T. Baer, *General Chronology of the Pennsylvania Railroad Company, 1815–1819* (May 2015), 66, 74, 75, 89, 90, 96, 102.

construct "a perfectly safe Dam"[43] at Fairmount. Lewis also asked Thomas Oakes[44] to provide a detailed analysis. His report included a hydraulic analysis of the river, a thorough description of the challenges of constructing a dam at Fairmount, a series of specific recommendations for various aspects of the design of a water power system at the site, and estimates of quantities of materials and costs.

Oakes determined water power was entirely feasible at Fairmount, despite the challenges. He also made two key recommendations that shaped the design of the dam. First, he judged that the river was too deep for a rock-filled crib design near the eastern shore and recommended an earthen mound dam for that portion of the dam.[45] Second, he suggested that a diagonal plan would spread the force from occasional floodwaters over a longer face and make the dam more resilient.[46] Altogether, he judged that a dam and locks would cost approximately $150,000.[47] If a mill house containing four breast wheels and pumps were included, Oakes estimated the cost at approximately $196,000.[48]

The four reports came in from January to March 1819. Oakes estimated $150,000[49] (as we have seen), Cooley $100,000,[50] Wernwag $147,960,[51] and Briggs and Lehman $96,000,[52]

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[43] Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 4.

[44] In March 1819 Thomas Oakes became Chief Engineer for the Schuylkill Navigation Company. He designed a section of the canal system that bears his name, the Oakes Reach, which stretched 3½ miles from the Black Rock Dam and Lock 60 at Phoenixville to Lock 61 at Oaks. He died in 1823 of typhoid or heat exposure (variously reported) while working for the canal company. The nearby town of Oaks, Pennsylvania is also named after him. See Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 474.

[45] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 476.

[46] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 476f.

[47] The equivalent of approximately $3.5 million in 2022.

[48] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 17ff. The amount was the equivalent of approximately $4.6 million in 2022.

[49] The equivalent of approximately $3.5 million in 2022.

[50] The equivalent of approximately $2.3 million in 2022.

[51] The equivalent of approximately $3.45 million in 2022.

[52] The equivalent of approximately $2.2 million in 2022.

with an average between the four of $123,490.[53]

While specifics were still being collected, Lewis was optimistic enough that on 5 Feb 1819 he submitted a report from the Watering Committee to Councils describing the developments to date and recommending the way forward. It was a full-throated recommendation of water power. All of the potential costs had not yet been ascertained, but "if water power can be obtained, at almost any cost, it will, in the end, be much cheaper than by the present mode."[54] In other words, powering Fairmount by steam was so expensive—over $30,800 per year,[55] according to an included report by Frederick Graff—that almost no matter what the capital outlay may be, the savings in operating expenses combined with the potential for the sale of water to adjacent municipalities would eventually more than pay for the new system. This was somewhat overstated, perhaps, but close to the truth as it turned out.

In a second report to Councils, submitted a month later after the proposals were received, the Watering Committee estimated the total capital cost of constructing a water-powered operation at Fairmount would be $346,000[56] even if the highest bid was accepted. This figure included the price of White and Gillingham's water rights. The Watering committee further estimated annual operating expenses of $2,100.[57] Adding $20,760[58] for annual payments on the loan necessary to finance the construction and subtracting $10,000 per year[59] in anticipated revenue from the sale of water to adjacent municipalities, the committee argued that the net

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[53] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 15ff. The average was the equivalent of approximately $2.9 million in 2022.
[54] Watering Committee, "Report of the Watering Committee" (5 Feb 1819), included in *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 6.
[55] The equivalent of approximately $718,300 in 2022.
[56] The equivalent of approximately $8.1 million in 2022.
[57] The equivalent of approximately $49,000 in 2022.
[58] The equivalent of approximately $484,100 in 2022.
[59] The equivalent of approximately $233,200 in 2022.

annual expenditure would be $12,860,[60] far less than the $30,858[61] the City of Philadelphia was annually shelling out while operating the steam engines at Fairmount. The committee projected the $17,998[62] in annual savings would pay for the new construction in approximately twelve years.[63]

In the same report, Lewis provided further justification for proceeding:

> The committee [Watering Committee] are sensible that the cost of the contemplated work is large; but … a safe and economical means of obtaining 10,000,000 of gallons of water can be had, in lieu of a costly and precarious supply of but little more than 2,000,000 [by steam power], and at the cost of not much more than one half, without calculating on the sale of a gallon to our neighbours in the districts…[64]

Lewis at once showed that the Watering Committee understood the transient nature of the convergence of the opportune events before them and expressed the committee's sense of urgency, as he went on to say,

> …councils should not reject a plan so long sought for; hitherto unattainable; and if now suffered to escape from our grasp, never to be reclaimed. The committee believe that their fellow citizens view with anxiety the accomplishment of a measure so important to the health of this great City…[65]

A little further in the report, Lewis put a fine point on his remarks, declaring "…if [the

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[60] The equivalent of approximately $299,900 in 2022.
[61] The equivalent of approximately $719,600 in 2022.
[62] The equivalent of approximately $419,700 in 2022.
[63] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 13f. See also Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 301n31.
[64] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 12.
[65] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 12f.

work] is to be executed at all, no time is to be lost."[66]

The Watering Committee negotiated an agreement with the Schuylkill Navigation Company on 23 Jan 1819 to build a dam and locks at Fairmount.[67] When the agreement was fleshed out in a more detailed document, it specified that the City of Philadelphia was to complete construction by 1 Jan 1822, barring "unavoidable accidents."[68] After the agreement with the Schuylkill Navigation Company was reached,[69] a subcommittee of the Watering Committee, consisting of Lewis, Samuel Williams, and Joseph Watson, began negotiations with White and Gillingham for the sale of their water rights. An asking price of $160,000[70] was accepted by the subcommittee on 29 Jan 1819,[71] but by 23 Feb the agreed-upon amount had been knocked down to $150,000.[72]

Philadelphia City Councils unanimously approved the plan[73] and passed an ordinance on 8 Apr 1819 which authorized an expenditure of $350,000[74] for a water power system. The City purchased the water rights from Josiah White & Joseph Gillingham for $150,000[75] on 17 Apr

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[66] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 13.
[67] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 24f.
[68] Watering Committee, *Report of the Watering Committee of the Agreements with the Schuylkill Navigation Company and White and Gillingham Relating to the Water Power of the River Schuylkill* (Philadelphia: 1819), 34; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).
[69] Watering Committee, "Report of the Watering Committee" (5 Feb 1819), included in *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 4f.
[70] The equivalent of approximately $3.7 million in 2022.
[71] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 23.
[72] Watering Committee, *Additional Report on Water Power by the Watering Committee* (Philadelphia: 8 Mar 1819), 24. The amount was the equivalent of approximately $3.5 million in 2022.
[73] Watering Committee, *1822 Annual Report* (9 Jan 1823), 4.
[74] The equivalent of approximately $8.2 million in 2022.
[75] The equivalent of approximately $3.5 million in 2022.

1819[76] and on 3 Jun paid the Schuylkill Navigation Company $25,000[77] for the right to build a dam at Fairmount.[78]

The City of Philadelphia didn't formalize its agreement with Cooley until it contracted with him on 23 Sep 1819 to build the dam, canal locks, and forebay for $150,000.[79] The sense of urgency must not have lessened because Cooley had already begun construction of Fairmount Dam on 19 Apr 1819, eleven days after City Councils' approval, likely on an informal go-ahead by the Watering Committee.[80] In the meantime, the City made a secondary agreement with the Schuylkill Navigation Company on 20 July that allowed it to construct the dam 18 inches higher than stipulated in the June agreement.[81]

Under the agreement with the canal company, the City agreed to construct the dam, a short stretch of canal, a lock system, and space for a toll house. When completed, the Schuylkill Navigation Company would have "exclusive possession and ownership" and "exclusive authority and control over" the stretch of canal, lock system, and toll house space, but the City

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[76] *Articles of Agreement Between Ariel Cooley and the Mayor, Aldermen, and Citizens of The City of Philadelphia* (1819); included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (1820). See also Josiah White, *Josiah White's History Given by Himself,* (reprint by Carbon County Board of Commissioners, 29 Jun 1979), 39.
[77] The equivalent of approximately $583,000 in 2022.
[78] *The Union,* 12 Apr 1819; quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 85, 301n32. See also Watering Committee, *1852 Annual Report* (6 Jan 1853), chart at 47; Water Department, *1875 Annual Report* (6 Apr 1876), 42. Watering Committee, *1822 Annual Report* (9 Jan 1823), 14, specifies 18 Apr 1819, possibly a typographical error.
[79] *Articles of Agreement Between Ariel Cooley and the Mayor, Aldermen, and Citizens of The City of Philadelphia* (Philadelphia: 23 Sep 1819), 43; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820). The amount was the equivalent of approximately $3.5 million in 2022.
[80] Watering Committee, *1822 Annual Report* (9 Jan 1823), 2; and *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: Manly, Orr, and Lippincott, 1842), 12. A contradictory date of 23 Sep 1819 is given in *Articles of Agreement Between Ariel Cooley and the Mayor, Aldermen, and Citizens of The City of Philadelphia* (Philadelphia: 23 Sep 1819), 43; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820). The likely explanation is that Cooley began construction before the contract was finalized.
[81] John K. Kane, Opinion of the City Solicitor, 3 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 12.

would be responsible for all maintenance, subject to the company's inspection. The canal company would have the right to as much water as it alone deemed necessary to operate its system of navigation and the City would have the right to any water beyond this amount, as long it did not reduce the level of the water below the top of the dam. The City also promised to cover any claims for damages or other lawsuits brought because of the construction of the dam.[82]

Lewis had earlier expressed just how eagerly the members of the Watering committee were anticipating their goal. "In presenting this subject to the Councils," Lewis proclaimed, "the Committee cannot but feel gratified that they now have it in their power to say, that the object so long desired may be accomplished….[83]

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Twenty years after the water-powered system at Fairmount was completed, an unknown author recorded an exchange between Joseph S. Lewis and William Rush while the two were part of a group examining the top of Fairmount during the steam operation days. While perhaps apocryphal, it does capture the spirit of the day.

> Some time before the present works were suggested seriously, Mr. [William] Rush was standing with others on the summit of Fairmount; at a pause in the conversation he placed his hands over his eyes, and turning playfully to Mr. Jos. S. Lewis, said, "I see! I see!"
>
> "What do you see?" inquired Mr. Lewis, "can you see with your eyes shut?"
>
> "Why I see," rejoined Mr. Rush, "I see those stones rolling into the Schuylkill and

[82] John K. Kane, "Opinion of the City Solicitor, 3 Dec 1832," *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 11f.
[83] Watering Committee, "Report of the Watering Committee" (5 Feb 1819), *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820), 5.

> forming a dam, and the river, by the aid of machinery, flowing over this hill to supply the city!"[84]

The three main components of the water-powered system at Fairmount were to be a dam, a mill house, and a reservoir. The dam would divert water to a forebay on its eastern end. From the forebay, the water would pass through a mill house containing breast wheels. The water would turn the breast wheels, the breast wheels would drive piston pumps, and the piston pumps would force some of the water from the forebay through pipes up to the reservoir. From the reservoir, the water would descend to the distribution system throughout the city.

Although easy enough to describe in a few sentences, it was a challenging undertaking at the time, especially if the project were to take full advantage of the available power of the river and be accomplished in a cost-effective manner.

Constructing the Fairmount Dam was a large part of the challenge. The Schuylkill River was nine hundred to a thousand feet across at the site chosen for the dam.[85] It is tidal at this location, with the tide rising and falling six feet twice per day on average.[86] The deepest point along its width was 30 feet at high tide. Both the depth and characteristics of the river bed were very different, however, from one side to the other. Near the west bank, the underlying bedrock was close to the surface. Rocky shoals projected from the water there at low tide.[87] For 240 feet from the east shore, however, the bedrock was covered by some 11 feet of mud,[88] but no one was

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[84] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), vii. The author cites "an undoubted authority" for the anecdote.
[85] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 18; Watering Committee, *1822 Annual Report* (9 Jan 1823), 5.
[86] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5.
[87] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5. Some of this rocky area may still be seen today just below the dam when the tide is out.
[88] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5.

sure exactly how deep the mud was at any given point.[89] Making matters worse, the Schuylkill River was subject to flash floods during all seasons of the year.[90]

If the dam were to be successful, it had to be responsive to the varying physical characteristics present along its length, point by point, across the width of the river. In his report to Watering Committee chairman Joseph S. Lewis, Thomas Oakes had recommended a crib design over the deepest part of the river where the bottom was rocky and a "mound dam" of earthen fill over the portion on the eastern end where the bottom was muddy.[91]

Ariel Cooley had recently finished construction of the Flat Rock Dam in Manayunk when the Watering Committee selected him to build the Fairmount Dam.[92] Although he was still in the midst of superintending numerous other projects for the Schuylkill Navigation Company,[93] he had a month earlier ended his tenure as Chief Engineer for the company.[94] A carpenter-builder at a time when such men gained their expertise through experience rather than training, Cooley had earlier built dams on the Connecticut River between Springfield, Massachusetts, and Hanover, New Hampshire. In 1795 he completed the South Hadley Canal on the Connecticut River and replaced an inclined plane with a series of five locks in 1805. Cooley also built the

[89] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 18.
[90] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5.
[91] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 18f. See also Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 475.
[92] Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 22. Cooley completed the Flat Rock Dam on 7 Nov 1818.
[93] Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 21, 22. Cooley maintained a close if stormy relationship with the Schuylkill Navigation Company, continuing to oversee multiple canal projects while constructing the Fairmount Dam (23f).
[94] Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 21. Cooley served as the company's Chief Engineer from Jan 1817 until he was replaced by Thomas Oakes in Mar 1819.

locks at the Falls of the James River in Richmond.[95] The Flat Rock Dam, not coincidentally, was a crib dam similar to the one proposed for Fairmount.

Following Thomas Oakes' recommendation, Cooley did not place the Fairmount Dam across the river at its narrowest point, but just upstream. Cooley also followed Oakes in situating it diagonally across the river, instead of perpendicular to the flow of water, with a bend at a right angle as it neared the Schuylkill Navigation system's locks on the western shore. The force of the water—and any debris or ice carried with it—would strike the dam at an angle, and along a greater length, allowing it to withstand greater force. It also allowed water to be more easily diverted to the water works' mill house on the east bank while diverting debris away from it. In the winter, sheets of ice would break up into smaller, less threatening pieces.[96]

What the public today generally thinks of as Fairmount Dam is in fact only the dam's overfall portion, only one of its five main parts. The other four—the canal locks on the western end of the dam and the Pier, Mound Dam, and Forebay Bridge on the eastern end—are integral parts of the dam as well because together they control the river's water and impound it upstream.[97] When taken together, the Fairmount Dam system was approximately 1,600 feet long.[98]

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While work on Fairmount Dam got under way in April 1819, Frederick Graff was away

[95] Robert J. Kapsch, "Twenty-five Years of Canal History," *Canal History and Technology Proceedings,* Vol. 25 (Easton, Pennsylvania, 2006), 117; Edwin F. Smith, "The Schuylkill Navigation," *Publications of the Historical Society of Schuylkill County*, Vol. 2 (Schuylkill County, Pennsylvania, 1910), 477.
[96] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.
[97] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5ff.
[98] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.

from the city procuring timber for its construction.[99] Upon his return he learned that in the rush to commence construction, the Watering Committee had neglected to contract with anyone to provide detailed plans for the water power system as a whole. Although Aerial Cooley was hard at work building the dam, and Thomas Oakes had provided both the rough configuration of the necessary elements of the system[100] and specific designs for the breast wheels,[101] no one had yet thought through the details of how the various elements would be integrated nor the necessary designs drawn up showing how the new structures were to be built.[102] Even Fairmount Dam, already under construction by Cooley, had no substantial guiding plan save for the experienced eye of its builder. Fearing the potential for slipshod design and construction in such an important work, Graff, in an act of civil dedication, took it upon himself to review and design nearly everything associated with the water-powered system at Fairmount.[103]

Most water power systems at this time consisted of a mill building with one wheel. Some systems also used part of the water for the operation within the mill, as at Thomas Gilpin's mills on the Brandywine Creek. There were a handful of examples of multi-wheel operations in Europe such as the London Bridge pumping station on the River Thames in England and the massive system on the River Seine at Marly in France. Graff's task was to design a water-powered system which would meet the needs of the current population of Philadelphia and be readily expandable as the city's needs grew.

Graff was faced with the challenge of crafting an entire system that integrated every

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[99] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 5. Graff was acquiring materials "up the Delaware," as he later put it.
[100] Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 17ff.
[101] Watering Committee, *1822 Annual Report* (9 Jan 1823), 11.
[102] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 5.
[103] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 5f.

element into a workable whole. He would need to design the canal locks, forebay, mill house, ascending mains, and expansion of the reservoir. The only components Graff didn't need to design from scratch were the Fairmount Dam itself and the breast wheels,[104] but even these required work on his part. Although the breast wheels were designed by the eminently competent and reliable Oakes,[105] they nonetheless needed to be integrated into the system. Graff would function as both engineer and architect, drawing on his experience as well as his imagination. He would soon be serving as contract manager and materials procurement agent as well,[106] all while supervising the continuing operation of Fairmount's steam-powered system.

Ariel Cooley's work on the Fairmount Dam was an entire issue of its own. Cooley seems to have been an old-style carpenter-builder, working from general requirements instead of a concrete plan and responding to challenges as they arose with solutions crafted from long years of experience in the field. Because of this, Graff's surviving diagrams of the Fairmount Dam represent what we would today call "as-built" drawings made afterward, not designs drawn up ahead-of-time showing how it should be built.

By this time, however, Graff was well-prepared for the task. He had already once been called upon to design and supervise the construction of an entirely new system, the steam operation at Fairmount, while simultaneously maintaining the successful operation of the old. Now he was doing something similar again. Through the spring and summer of 1819 Graff set about making detailed engineering plans. He not only created numerous drawings of proposed

[104] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 5f.
[105] In Mar 1819 Oakes was selected by the board of the Schuylkill Navigation Company to replace Aerial Cooley as its Chief Engineer. He served in that position until his untimely death from typhoid in 1823.
[106] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 5.

designs but also crafted wood models in order to better visualize the completed work.[107] His drawings and models show the meticulous care he took with the design.[108]

The starting point was of necessity the space available for the Mill House. The Engine House had to stay put; although the steam-powered pumping system would no longer be needed for pumping when the water-powered system went on line, it was at this time still providing water to the city. Graff designed the Mill House to fit within the space between the Engine House and the proposed Mound Dam.

Graff planned the Mill House around the internal configuration of the breast wheels and their pumps. Each wheel would drive a pump dedicated to only that wheel. Although only three wheels would be initially installed, Graff wisely designed the Mill House to be constructed from the start with room for eight wheels and pumps. Not only would this be more economical in the long run, it would allow for continuous operation during future expansion. If the structure of the Mill House had needed to be enlarged whenever additional wheels were to be added, it's likely at least some of the existing wheels would have needed to be stopped during construction, causing operational difficulties. Building out the entire facility at the start avoided this problem altogether.

In order to accommodate the full complement of eight breast wheels and eight pumps, and fit the building within the available space, Graff made the structure 230 feet long and 56 feet wide.[109] Graff arranged the interior of the Mill House in a line of twelve separate compartments,

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[107] Frederick Graff, *Old Mill House* (unknown date), model, wood, 30 5/8" long × 7 1/4" tall × 4 1/16" deep, Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University. Although this single model of the Mill House is the only known to be extant, in his *Memorial* of 1833 Graff mentioned "making models" (plural).
[108] See for example "Plan of the Mill Buildings at Fairmount Designed by Frederick Graff in 1819." This and many similar reside in the collection of The Franklin Institute. Additional drawings are part of the collection of the Philadelphia Museum of Art.
[109] Watering Committee, *1822 Annual Report* (9 Jan 1823), 9; "Plan of the Mill Buildings at Fairmount, designed by Frederick Graff in 1819," Drawing V:22, collection of The Franklin Institute.

one for each of the planned wheels and one for every two pumps. Dedicated barrel-vaulted, brick-lined flumes (or head races), one for each wheel-and-pump set, penetrated the rear wall and led from the Forebay to the each of the breast wheels. The south end of the Mill House contained a waste gate, a channel which allowed the Forebay to be emptied for purposes such as repair and maintenance. Graff's attention to detail extended to the building's heating by coal-burning cast-iron stoves.[110]

For the exterior of the Mill House, Graff called upon the vernacular of the classical period. In a city composed entirely of brick or wood structures, Philadelphians had first seen neoclassical architecture with the completion of the First Bank of the United States in 1795, as well as the Bank of Pennsylvania in 1799 and the Centre Square Engine House of the first water works in 1801, the latter two designed by Benjamin Latrobe. By now the Second Bank of the United States, designed by noted Philadelphia architect William Strickland, was under construction.[111] Here Graff reaped the benefit of his early experience with the Carpenters' Company and as an assistant to Latrobe, for both had libraries with books on architecture and construction which would have been available to him. Strickland, an apprentice to Latrobe during the creation of the Schuylkill and Centre Square Works, later commented on the value of this opportunity, stating that "while a pupil's daytime activities were mainly tasks of practical use to Latrobe, his nights were spent with books that exposed him to the most Neoclassical models."[112]

Graff's design for the Mill House featured a wide, relatively low, dressed stone design, with arched openings for the eight tail races across the riverside face, and two temple-like

[110] Watering Committee, *1822 Annual Report* (9 Jan 1823), 8ff.
[111] Construction began in 1818 and would be completed in 1824.
[112] James F. O'Gorman, et al, *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for the Pennsylvania Academy of the Fine Arts), 45.

superstructures, one atop either end. The structure on the north end provided an office and meeting space for the Watering Committee, and came to be called, sensibly enough, the Watering Committee Building. The south structure served as living quarters for a resident custodian and came to be called the Caretaker's House. A 26-foot-wide terrace, railed and paved with brick, extended the length of the building on the Forebay side at a level roughly halfway between the level of the water in the Forebay and the level of the walkway atop the Forebay Bridge.[113]

It is likely that Graff found inspiration for his design of the Mill House from the work of Andrea Palladio, the renowned 16th Century Italian architect. He would probably have been exposed to Palladio's work while he studied under and worked for Latrobe. By the time he was designing the Fairmount Water Works, Graff may even have had his own copies of Palladio's books. This would not have been uncommon for a man in Graff's field of endeavor.

There is a striking similarity between the Mill House and Palladio's drawing of "A Stone Bridge of My Own Invention" from the third of his *Four Books of Architecture.*[114] The illustration depicts an extended stone bridge with three arches over a river, buildings on the bridge for shops, and a temple-like structure at each end. When viewed from across the Schuylkill River, in fact, Graff's Mill House might well be described as a "faux bridge."

Palladio based his bridge designs on Roman examples because there simply are no Greek examples to go on. Though later modified, the overall composition and impression of Graff's design survives to this day. As a classically influenced bridge-like structure, then, the architecture of the Fairmount Water Works' Mill House is not Greek Revival, as most casual

[113] Watering Committee, *1822 Annual Report* (9 Jan 1823), 10.
[114] Andrea Palladio, *I Quattro Libri dell'Architettura,* Il Terzo Libro (Venice, 1570), 25ff.

observers suppose, but Roman.[115]

At the western end of Fairmount Dam, Ariel Cooley was building the Graff-designed components of the Schuylkill Navigation system. At 569 feet overall, it consisted of a head pier and guard lock on the upstream end, two chamber locks on the downstream end, and a short stretch of canal between the two. The entire structure was built of dressed stone. Each chamber lock raised or lowered canal traffic six feet. Below these locks there was an additional stretch of canal 420 feet long leading back into the Schuylkill River below Fairmount Dam. The lower section was protected from erosion by the placement of broken rock (today called "rip-rap") along its riverside edge.[116]

Following Oakes' recommendation, Cooley used a crib design for the 1,204-foot-long overfall portion of Fairmount Dam.[117] Engineers today sometimes refer to this as a "gabion"[118] design—a type of cage filled with loose material. Gabion construction may often be seen today, for example, serving as low retaining walls for roadway cuts or embankments. Modern versions often look like stacked cages made of large-gauge chicken wire filled with crushed rock. Gabion design is not new, however. The more remote reaches of the Great Wall of China, for example, were constructed not of stone masonry like the more familiar sections but of large wicker baskets filled with soil and debris and arranged atop one another like blocks.

For the Fairmount Dam, the "cage" component was a series of wood frames—called "cribs"—made of hemlock logs held together with locust pins. The fill inside the cribs was

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[115] So Arthur S. Marks, "Palladianism On the Schuylkill: The Work of Frederick Graff at Fairmount," *Proceedings of the American Philosophical Society*, Vol. 154, No. 2 (Philadelphia: Jun 2010), 201ff. Professor Marks is likely the first to make the connection between the Mill House and Roman (versus Greek) classicism using cogent research and analysis. His argument is coherent and compelling. Lending support to Marks' thesis is the fact that the river side of both the Watering Committee Building and Caretaker's House feature columns of the Roman Tuscan order, not any of the Greek orders (Doric, Ionic, or Corinthian).
[116] Watering Committee, *1822 Annual Report* (9 Jan 1823), 7. This type of material is today known as "rip-rap."
[117] Watering Committee, *1822 Annual Report* (9 Jan 1823), 3.
[118] Pronounced "GAY-bee-uhn."

composed of loose rock. The wood cribs were floated to their places empty and then sunk, by filling them with the rock, to the bottom of the river where they were anchored to bedrock.[119]

The Mound Dam component, on the eastern end of Fairmount Dam, is 270 feet long,[120] 150 feet wide at its base and 12 feet wide at its crest. The top of the crest was originally intended to be built seven feet higher than the overfall,[121] but the height difference was increased to 15 feet after a freshet occurred shortly after the dam was completed. It is composed of earth and spalls of rock created by the excavation of the Forebay. Its design and composition is a response to the inability to penetrate through the mud to the bedrock at the eastern end of the dam. The top and upstream side was covered with rip-rap three feet deep in order to prevent scour erosion, much like the lower portion of the canal on the west end.[122]

The Pier, built between the Mound Dam and overfall portion of the dam, anchors the two together. Composed of dressed stone, it measured 28 feet by 23 feet as originally constructed and was sunk 28 feet down to the underlying bedrock. Its top surface is a foot or so higher than the crest of the Mound Dam.[123]

At 419 feet long, the Forebay was shaped like a wide, shallow V and was situated behind the Mound Dam and the Mill house. The arm of the V behind the Mound Dam is sometimes called the outer Forebay; the arm behind the Mill House the inner Forebay. The inner Forebay was approximately 90 feet wide and 230 feet long. The total width of the excavation, from the front of the site of the Mill House at the river's edge to the back of the Forebay, was 140 feet.[124]

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[119] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5.
[120] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.
[121] *Articles of Agreement Between Ariel Cooley and the Mayor, Aldermen, and Citizens of The City of Philadelphia* (Philadelphia: 23 Sep 1819), 45; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).
[122] Watering Committee, *1822 Annual Report* (9 Jan 1823), 5f.
[123] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.
[124] Watering Committee, *1822 Annual Report* (9 Jan 1823), 7f.

Cooley's team used black powder to quarry out of the bedrock the Forebay and the site of the Mill House, down to a depth of six feet below the level of the overfall of Fairmount Dam and 60 feet from the top of the nose of the original slope. The blasting caused temporary damage to the Engine House; necessary repairs were made in 1823.[125]

Where the two arms of the Forebay's V met, the 104-foot-long[126] stone Forebay Bridge spanned the Forebay from the northeast corner of the Mill House to the rocky bank. Designed by Graff and considered a continuation of the Fairmount Dam, it was a part of Cooley's contract.[127] The Forebay Bridge was supported by an abutment on either end and two piers which stood within the Forebay. Between the abutments and the piers were three closed-spandrel arches. Each of the arches was fitted on the upstream side with a head gate to control the flow of water to the Forebay. The center gate featured a lock which allowed small boats to pass from the outer Forebay to the inner Forebay when there was a difference in the water levels. Together, the three arches had a total open span of 68 feet.[128] In addition to the bridge's water control function, the paved deck provided convenient access across the Forebay to the Mill House and Mound Dam.

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As work on the Fairmount Dam continued through 1819 and 1820, progress was not entirely smooth. William Rush, as chairman of a building subcommittee of the Watering Committee, had the task of monitoring all construction, while Frederick Graff directly supervised

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[125] Watering Committee, *1823 Annual Report* (8 Jan 1824), 9.
[126] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.
[127] *Articles of Agreement Between Ariel Cooley and the Mayor, Aldermen, and Citizens of The City of Philadelphia* (Philadelphia: 23 Sep 1819), 46; included in Watering Committee, *Report of the Watering Committee on the Subject of Obtaining Water Power from the River Schuylkill* (Philadelphia: 1820).
[128] Watering Committee, *1822 Annual Report* (9 Jan 1823), 8f.

it. Rush and others became convinced that the dam would not be high enough to provide the predicted power. Less than four months after construction began, the Watering Committee renegotiated the agreement with the Schuylkill Navigation Company and obtained the authority to raise the level of the dam's overfall by eighteen inches.[129]

In early 1820, the Watering Committee became dissatisfied with the quality of some of Cooley's work and forced him to tear down a substantial portion which had already been completed and rebuild it in a more robust manner.[130] Graff contracted with carpenter-builder Frederick Erdman to fix another problem. Erdman, who was constructing the wood components of the Mill House, was asked to modify some of Cooley's Fairmount Dam work. Concerned that wood cribs on the downstream side of the dam that had not yet been faced were allowing the rock fill to escape, Graff had Erdman cover the cribs with wood planking.[131]

While Cooley's relationship with the City's Watering Committee had become strained, his relationship with the Schuylkill Navigation Company was downright contentious. The construction of the Fairmount Dam needed to satisfy the company's managing board because the structure was a critical component of the canal system. The board was already dissatisfied with Cooley's work at several sites and now Fairmount was added to the list. Although Fairmount Dam was substantially completed in June 1821 and the Watering Committee gave its final approval by the end of that year, the Schuylkill Navigation Company was so dissatisfied with the

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[129] Watering Committee, *Report of the Watering Committee on the Propriety of Raising the Dam at Fairmount* (Philadelphia: Lydia R. Bailey, 1820), 3ff, quoted in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 86, 301n34. See also *1852 Annual Report* (6 Jan 1853), chart at 46ff. Annual report for 1852 specifies 20 Jul 1819 as the date the authority was obtained.

[130] *Philadelphia Gazette* (8 Jan 1830); cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 86, 301n33. Although Blake cites 1830 as the date of the article in the *Gazette*, this must be an error.

[131] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 6.

canal and locks at the western end that it did not consider that portion of the dam to be finished until 1824.[132]

Fairmount Dam's last crib was secured in place on 25 Jun 1821;[133] the dam began impounding water in a pool which soon stretched for six miles upstream, past the Falls of the Schuylkill and submerging the fall line there.[134] It took nearly a month for the pool to fill; water began pouring over the overflow portion of the dam for the first time on 23 Jul.[135]

Shortly after it was completed, Fairmount Dam was tested by nature. On 21 Feb 1822, a winter freshet occurred, the worst in living memory up to that time. Water and ice floes crested eight feet over the top of the overflow but the dam held secure, passing its stress test with seeming ease.[136] The flood did bring about one change. It stimulated Graff to increase the height of the Mound Dam.[137]

Ariel Cooley did not live to enjoy the successful completion of the project, however. Often seen using a cane or hobbling on crutches, he must have been in poor health. He was certainly under tremendous strain as he shuttled between his work on Fairmount Dam and his multiple concurrent projects for the Schuylkill Navigation Company along the length of the river. In any event, he died shortly before the dam was completed. As the Annual Report for 1822 put

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132 Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 25f.

133 Watering Committee, *1821 Annual Report* (24 Jan 1822), Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"), Watering Committee, *1852 Annual Report* (6 Jan 1853), 47, and "Plan of Mill Buildings at Fairmount, designed by F. Graff 1819," Collection of The Franklin Institute. Annual Report for 1821 indicates works substantially completed in 1821 with minor finishing work to be concluded in 1822. Annual Report for 1852 indicates Fairmount Dam completed 23 Jul 1821, but Annual Report for 1849 and Graff drawing specify 25 Jun 1821.

134 Watering Committee, *1822 Annual Report* (9 Jan 1823), 6.

135 Watering Committee, *1852 Annual Report* (6 Jan 1853), 47, and "Plan of Mill Buildings at Fairmount, designed by F. Graff 1819," Collection of The Franklin Institute. Annual Report for 1852 specifies first water flowed over Fairmount Dam Jan (no day) 1821, but Graff drawings specify 23 Jul 1821.

136 Watering Committee, *1822 Annual Report* (9 Jan 1823), 14.

137 Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833), 6.

it, Cooley was "taken off by disease, supposed to have been contracted by his exposure to the sun and night air at the closing part of his work."[138] His executors paid $2,000[139] back to the Watering Committee for work paid for but not yet performed at the time of his death. At some point before the dam was completed, moreover, Cooley had mortgaged his two estates for a period of five years to begin in February 1822 as a guarantee against the dam's successful completion. After his death, the City of Philadelphia continued to hold the mortgage for the specified period.[140]

With Fairmount Dam finished, work began on the remainder of the system with the laying of the Mill House cornerstone on 1 Jul 1821.[141] Situated between the Forebay and the river, the Mill House was constructed of dressed stone with a wood roof and superstructure. Its foundation rested directly upon the bedrock shelf excavated by Cooley and fit snugly between the ends of the rock ledge left intact on either end of the excavation.

Graff contracted with mason John Moore and carpenter-builder Frederick Erdman to carry out his design. It was noted that upon completion the masonry work was so well constructed that there was no leakage under the six-foot head of water anywhere in the building.[142]

After the structure of the Mill House was completed, three breast wheels were installed at the southern end of the building, nearest the Engine House.[143] At the advice of Thomas Oakes, who designed them,[144] the Watering Committee asked millwright Drury Bromley to construct

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[138] Watering Committee, *1822 Annual Report* (9 Jan 1823), 4f.
[139] The equivalent of approximately $52,400 in 2022.
[140] Watering Committee, *1823 Annual Report* (8 Jan 1824).
[141] Watering Committee, *1853 Annual Report* (5 Jan 1854), 33. See also Frederick Graff, Jr.'s *Notes* c.1872.
[142] Watering Committee, *1822 Annual Report* (9 Jan 1823), 10.
[143] An initial set of four was originally planned. Cf. Watering Committee, *Additional Report on Water Power, by the Watering Committee* (Philadelphia: 8 Mar 1819), 20f; with Watering Committee, *1822 Annual Report* (9 Jan 1823), 10.
[144] Watering Committee, *1822 Annual Report* (9 Jan 1823), 11.

them.[145] Wheel No. 1 was 15 feet wide and 15 feet in diameter. Wheels No. 2 and 3 were of the same width but slightly larger with a diameter of 16 feet. All three were constructed entirely of white oak,[146] except for their iron shafts which alone weighed approximately five tons each.[147] The wheels worked under a one-foot head of water and a 7- or 7½-foot fall of water, depending on the diameter of the wheel.

The pumps Graff designed[148] for the Mill House were essentially the same as those he had designed for the steam system, but as Oakes had envisioned he positioned them nearly horizontally instead of the vertical arrangement in the Engine House.[149] Driven by a shaft connected to a breast wheel by a pitman arm (a type of connecting rod), each pump was double-acting, meaning it pushed water as the piston moved in both directions.[150] The three were nearly identical, with a 16-inch interior diameter. The first two had a stroke of 4½ feet; the third a stroke of 5 feet. The pumps and their related equipment were built by the Rush & Muhlenberg foundry,[151] run by Oliver Evans' sons-in-law James I. Rush and Peter D. Muhlenberg.[152] Graff employed anthracite-burning iron stoves to heat the operational areas of the Mill House to prevent potentially damaging ice from forming during the winter.[153]

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[145] Watering Committee, *1822 Annual Report* (9 Jan 1823), 12. See also Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography*, Vol. 37 (Philadelphia: 1913), 476f. Oakes and Bromley were business partners. When Oakes was asked to be Chief Engineer for the Schuylkill Navigation Company in March 1819, Bromley assumed his responsibilities at Fairmount.
[146] "A Study Drawing of Water Wheels," drawing and notation by Frederick Graff, collection of The Franklin Institute, Philadelphia.
[147] Watering Committee, *1822 Annual Report* (9 Jan 1823), 11f.
[148] Graff drawings, collection of The Franklin Institute, Philadelphia. Graff's work included the design for the valves and valve seats.
[149] "Plan of Thomas Oakes for the Wheels and Pumps at Fair Mount in 1819, with Lever Beams and the Pumps Place Perpendicular," Graff drawings, collection of the Philadelphia Museum of Art.
[150] Franklin Institute of the State of Pennsylvania, *Franklin Journal and American Mechanics Magazine*, Vol. III (Philadelphia: Judah Dobson, 1827), 65.
[151] Watering Committee, *1822 Annual Report* (9 Jan 1823), 12f.
[152] Rush and Muhlenberg reorganized Evans' Mars Works shortly after it burned down four days before the inventor's death on 15 Apr 1819.
[153] Watering Committee, *1822 Annual Report* (9 Jan 1823), 9; Watering Committee, *1823 Annual Report* (8 Jan 1824), published in Public Works of the United States of America (London: John Weale, 1841), 113.

A man named Daniel Large, with whom Graff had worked repairing the pumps in the Engine House in 1816, challenged Graff's claim to have designed the Mill House pumps. Graff successfully defended his priority, however.[154]

Three 16-inch iron ascending mains, one from each of the pumps, led out the back of the Mill House and across the bottom of the Forebay beneath the surface of the water. At the base of the rocky hill, the mains emerged from the Forebay and rose side by side up the steep slope to the Fairmount Reservoir at the summit. Each had a stopcock valve at the top. Here again, Graff used foresight. Although only the first three ascending mains were constructed at this time, connections for all eight were built into the reservoir so that when the five additional wheel-and-pump sets would eventually be installed, their associated ascending mains could be easily connected without tearing apart the reservoir wall and drawing down the water level in order to do so.[155]

The vertical lift from the pumps to the reservoir was 92 feet, but the shortest among them was 284 feet long because they rose at an angle. The weight of the column of water within each main, which each pump pushed against, was 7,900 pounds. The rise to the reservoir from the level of low tide was 102 feet. The level of the reservoir was 56 feet above the highest point in the city.[156]

Frederick Graff also designed an enlargement of the Fairmount Reservoir. He added a second basin, measuring 316 feet long by 139 feet wide by 12 feet deep. The ascending mains from the Mill House fed directly into the new basin which was in turn connected to the original

[154] Graff to Samuel Wetherill, 19 Oct 1824; quoted in Karin E. Peterson, "The Philadelphia Water Works," unpublished ms.,18.
[155] Watering Committee, *1821 Annual Report* (24 Jan 1822), 3.
[156] Watering Committee, *1822 Annual Report* (9 Jan 1823), 123f. Recall that the boundaries of the City of Philadelphia at this time were from the Delaware River to the Schuylkill River and from Vine Street to Cedar Street (South Street), or roughly what is today known as Center City.

via two 20-inch pipes with stopcocks. The addition of Basin No. 2 increased the reservoir's capacity by three million gallons to a total of approximately seven million gallons.[157]

Having a large amount of space atop Fairmount allowed Graff to design the reservoir to be expandable as the Mill House operation expanded. As additional breast wheels were added and the pumping capacity increased, there was space to construct additional basins to receive the additional water.

In the meantime Graff was also busy beginning the conversion from wood mains to cast iron. You'll recall that the distribution system which the Fairmount Water Works inherited in 1815 from its predecessor consisted of pipes fashioned from spruce and yellow pine logs bored to interior diameters of six, four, or three inches. When steam operations began at Fairmount in 1815, Graff would have liked to have connected the Fairmount Reservoir to the existing distribution system with a single 14-inch cast iron main, but he was forced instead to use five smaller parallel wood mains because of the uncertainty over the suitability of cast iron, the high cost of iron pipes which initially had to be imported from Britain, and doubts about whether a British supplier would be able to manufacture and ship the lengths of iron pipe in time for them to be installed and useable when the other components of the system were ready to become operational.

By 1817 the system had grown to a little over 32 linear miles.[158] Bursting of the pipes had been a perennial headache, as was leakage at the joints.[159] Perhaps the greatest shortcoming, however, was the limited capacity of the log pipes due to small interior bore, high friction between the water and the wood, and the right-angle joints at every corner and intersection

[157] Watering Committee, *1822 Annual Report* (9 Jan 1823), 13.
[158] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18.
[159] Watering Committee, *1822 Annual Report* (9 Jan 1823), 17.

necessitated by the limitations of the material. By the time the issue was brought to a head in the summer of 1818 by a severe, city-wide water shortage caused by these constraints,[160] Graff, as we have seen, had already been researching the use of cast iron. He had obtained sample pipe segments and corresponded with an engineer in London who had extensive experience with their use. When Joseph S. Lewis, the chairman of the Watering Committee, submitted Graff's recommendation to switch to cast iron mains and pipes to City Councils in November 1818,[161] the supporting documentation—including cost estimates—was such that Councils wasted no time approving the recommendation. Councils gave its authorization in January 1819 and appropriated $70,000[162] toward the conversion.[163]

On 25 Jun 1820,[164] Graff completed the replacement of the six wood mains leading from the Fairmount Reservoir to the distribution system with a single cast iron main.[165] Leading from the reservoir to the new main was a novel funnel-shaped pipe with an interior diameter of 30 inches tapering to 22 inches. Half of a mile downstream, the main further reduced to 20 inches.[166] This 20-inch iron main was laid beneath Hunter Street (along the north side of Fairmount Reservoir), along the old unfinished Union Canal bank to Callowhill Street, then along Callowhill Street to Broad Street and down Broad Street to Chestnut Street, a distance of approximately 1⅓ miles.[167] This first cast iron main from Fairmount Reservoir connected to the existing distribution system at the intersection of Broad and Chestnut Streets, a block south of the southern edge of Centre Square. As it ran down Broad Street, past Centre Square where the

[160] Watering Committee, *1818 Annual Report* (14 Jan 1819), 3.
[161] Watering Committee, *1818 Annual Report* (14 Jan 1819).
[162] The equivalent of approximately $1.6 million in 2022.
[163] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18; Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.
[164] Watering Committee, *1852 Annual Report* (6 Jan 1853), 47.
[165] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18.
[166] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18. The precise distance was 2,661 feet.
[167] Or 6,909 feet.

old Centre Square Engine House still stood, the new connecting main bypassed the iron distribution chest which had until that time been the connecting point with the distribution system. The chest, located below ground on the east side of the engine house, was abandoned.[168]

The relatively large interior diameter of the iron connecting main reduced friction between the water and the iron material. This, along with the improved joints and curved corners designed to reduce turbulence, virtually eliminated one of the significant distribution bottlenecks.[169]

The Watering Committee also began to replace some of the wood mains in the distribution system itself. The wood mains on Market Street between Broad and Water Streets, Chestnut Street between Broad and Water Streets, Walnut Street between 6th and Water Streets, and Front Street between Market and South Streets were all either in the midst of early conversion to iron or on the immediate schedule for it.[170] The Watering Committee attempted to procure so much cast iron pipe that American foundries were at first unable to meet the demand and the committee was forced to acquire some of its pipe from Britain.[171] Councils petitioned the United States Congress for a waiver of the tariff on imported iron pipe but the request was denied.[172]

The standardized shape of the cast iron segments made connecting them comparatively easy. Called a spigot-and-faucet system at the time, the pipes featured the now-familiar flange or lip around the outside edge of one end, and a plain end at the other. The unflanged, spigot end

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[168] Graff to Joseph S. Lewis, 14 Jul 1819, City of Philadelphia Archives, cited in Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 20, and Watering Committee, *1822 Annual Report* (9 Jan 1823), 18.

[169] Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978),18ff.

[170] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18f.

[171] Watering Committee, *1822 Annual Report* (9 Jan 1823), 21f.

[172] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. I (Philadelphia: L. H. Everts & Co., 1884), 597.

was fitted into the flanged, faucet end and sealed with hemp roping and molten lead.[173]

There remained, however, many miles of wood mains in the distribution system beneath the streets of Philadelphia which would need to be replaced in the coming years.

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If the Watering Committee and Councils needed a reminder of one reason the switch from steam to water power was at the time a good thing, the steam-powered system itself provided one. An explosion of the high-pressure steam engine's boiler had already killed one man, on 20 Jun 1818.[174] While construction on the water-powered system was under way, on 10 October 1821 the same engine's boiler exploded again, peppering two men with ash and mortally scalding them. One lingered for three days, the other even longer, before succumbing to their ghastly injuries.[175] No record suggests, however, that the boilers were either designed or operated with any malfeasance. Repairs costing $833 were necessary.[176]

Wheel No. 1 began operating on 1 Jul 1822, turning at 11½ revolutions per minute (rpm) and raising 1¼ million gallons a day up to Fairmount Reservoir. Wheel No. 2 followed on 14

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[173] Watering Committee, *1818 Annual Report* (12 Nov 1818), 13ff; Watering Committee, *1822 Annual Report* (9 Jan 1823), 20.

[174] Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876). "The boilers were wrought iron, 27 feet long, 27 inches diameter, and four in number, upon which steam was at times raised to 200 pounds to the square inch; they were twice burst, three men being killed by the explosion, the first time June 20, 1818; and again October 12, 1821." This refers to the two boiler explosions (1818 and 1821) together. Since a contemporaneous newspaper account describes two deaths in the 1821 boiler explosion, we can deduce that one man was killed in the 1818 incident. Note that Graff cites 12 Oct 1821 as the date of the second explosion while the contemporaneous newspaper account cites a specific day, "Wednesday of last week," prior to publication, viz. 10 Oct 1821.

[175] *Evening Post* (New York, New York), Fri 19 Oct 1821 (source: GenealogyBank.com), *National Gazette* (Philadelphia, Pennsylvania), 20 Oct 1821, 3 (source: GenealogyBank.com), and *National Gazette* (Philadelphia, Pennsylvania), Sat 27 Oct 1821, 3 (source: GenealogyBank.com).

[176] The two boiler explosions and necessary replacement or repairs may account for the differing sets of dimensions described in the 1852 Annual Report and Graff, Jr.'s *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876). The amount was the equivalent of approximately $21,800 in 2022.

Sep 1822, turning at 13 rpm and raising 1⅓ million gallons per day (which was eventually pushed to 1½ million), and Wheel No. 3 came online on 24 Dec 1822, also turning at 13 rpm and raising 1½ million gallons per day.[177] On 24 Oct 1822, even before the third breast wheel began operating, the steam engines were shut down.[178] Philadelphia's water works was now entirely water-powered.

At its most basic, the Fairmount Water Works used the weight of falling water from the Schuylkill River to drive pumps which raised additional water from the Schuylkill River to a reservoir. Put another way, the system harnessed one part of the river to power the collection and capture of another part of the river.

Water impounded behind Fairmount Dam was channeled to the outer Forebay at the dam's eastern end. The water then flowed through the head arches beneath the Forebay Bridge into the inner Forebay and from there into the Mill House through three flume gates. Passing each flume gate, the water then flowed into a flume, or narrow channel, for one of the breast wheels. The flume directed a stream of water foot-high and the width of the breast wheel onto the wheel's blades. The weight of the water caused the wheel to turn. The water fell seven feet[179] with the turning wheel and exited the Mill House through a short tail race into the river. It was estimated that 40 gallons of water needed to fall through each wheel for every gallon of water the wheel's pump raised up to the reservoir.[180]

A pitman arm attached to the side of the breast wheel changed the rotating motion of the

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[177] Watering Committee, *1822 Annual Report* (9 Jan 1823), 11, provides the dimensions and dates of first operation. Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 (*Statistics Relating to Fairmount Water Works*), and Watering Committee, *1852 Annual Report* (6 Jan 1853), 47, indicate first operational wheel pumped water to Fairmount Reservoir 25 Oct 1822, but 1849 AR also states "Started the Water Power Works, July 1, 1822."

[178] Watering Committee, *1822 Annual Report* (9 Jan 1823), 14. Watering Committee, *1852 Annual Report* (6 Jan 1853), 47, indicates steam discontinued 14 Jan 1822, but this seems unlikely since no source indicates any breast wheels began operating before 1 Jul of that year.

[179] Watering Committee, *1822 Annual Report* (9 Jan 1823), 11.

[180] Watering Committee, *1822 Annual Report* (9 Jan 1823), 17.

wheel to the reciprocating motion necessary to drive the piston back and forth within the pump. With each direction the pump's piston moved, it drew water from openings in the side of the wheel's flume and pumped it through a dedicated ascending main 92 feet vertically to the Fairmount Reservoir. From the reservoir, the water descended to the system of distribution mains throughout the City of Philadelphia.

Using water power, the Fairmount Water Works was now far more financially economical than it had been when powered by steam. The total construction cost of the new system, including the expansion of the Fairmount Reservoir and purchase of White and Gillingham's water rights, was $426,330.[181] In 1819, Graff had reported that the annual operating expense for the steam operation was $30,858[182] while raising a maximum of 1.6 million gallons of water per day to the reservoir. While operating with only the first three breast wheels, the water power operation raised 4.25 million gallons of water per day for only $22,816 per year.[183] And this figure included an annual five percent interest, $21,316,[184] on the loan for the capital outlay.[185]

Put another way, were the steam-powered operation to raise the same amount of water to the reservoir as the water-powered operation, if it could do it at all, it would cost nearly four times as much as the water-powered operation, or over $80,000.[186] In other words, the water power was just a little over one quarter of the cost of the steam power. And that included the interest on the debt; without that, it was only about two percent of the cost of steam.

At long last, the City of Philadelphia had a safe, economical, water-powered water works.

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[181] The equivalent of approximately $10.8 million in 2022.
[182] The equivalent of approximately $719,600 in 2022.
[183] The equivalent of approximately $577,600 in 2022.
[184] The equivalent of approximately $539,600 in 2022.
[185] Watering Committee, *1822 Annual Report* (9 Jan 1823), 14ff.
[186] The equivalent of over $2 million in 2022.

The system could provide all the water the city needed, so much that it could consider selling some of it to nearby municipalities for a profit. And it was easily expandable as the needs of the city grew. An anonymous writer to the *National Gazette,* a local newspaper, described the prospect before the city:

> The quantity of water supplied by the whole machinery when completed, will be from eight to 10 millions of gallons in 24 hours. The three pumps to be finished the present season will alone give upwards of three millions, double the quantity heretofore supplied by the two steam engines…[187]

The writer went on to list many of the men involved in the project, from the members of the Watering Committee and Councils to the various contractors, before concluding:

> I take particular pleasure, as a Philadelphian, in speaking of these gentlemen; and in that character also, I claim the liberty of saying that the perfect accuracy with which all the details of our watering system are arranged, and much of the precision with which the present works in their various parts have been followed out to the success before mentioned, is attributable to Mr. Graff, the superintendent, a man whose capacity in this branch is surpassed only by his modesty, and who has been for many years among the most valuable officers that any city ever had.[188]

The letter was signed simply, "AQUARIUS."

Twenty years later, the author of a description of the Fairmount Water Works would say of this work:

> The gratification arising from such an achievement partakes of the refined and placid character of the pure element they have been instrumental in supplying, which is at once the means of "health, and peace, and safety," to a whole community. … [T]hese names, graven

[187] *National Gazette* (5 Jul 1822).
[188] *National Gazette* (5 Jul 1822).

deep in the hearts of their fellow men, will be loved and praised as long as "wood shall grow and water run."[189]

[189] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: Manly, Orr, and Lippincott, 1842), viii.

CHAPTER 4

EARLY OPERATIONS

On 1 Jul 1822 the *National Gazette* in Philadelphia carried a jubilant report of the opening of the water-powered system at the Fairmount Water Works. Here, finally, was the answer to the city's more than twenty-year search for a satisfactory supply of water for the city. The writer caught the spirit of the times in describing the occasion:

> On the first of the present month, the councils and officers of the city, with several of the citizens, attended the first public exhibition of the new Waterworks at Fair Mount. The spectacle was so full of satisfaction to all present, and a theme of such high praise to the gentlemen who have had the management of the great work, of which it demonstrated the perfection, that I hope you will permit a spectator to use your Gazette, for the purpose of imparting some of this satisfaction to the public at large. The works recently erected at Fair Mount are a proud monument to the city of Philadelphia; but as a specimen of consummate art, and an instance in which the genius and industry of man have controlled to the purpose of domestic comfort, the entire waters of a deep and powerful river, they are an honour, and will doubtless be a subject of interest to the whole of this country.[1]

Even before all three breast wheels were put into service, a test of sorts was run. For eighteen days straight in July 1822, four fire hydrants were kept open during the daytime for washing the gutters, supplied by the first two breast wheels working only fourteen hours a day. The two wheels handled the load easily. In the end the daily amount of water raised was roughly 1,250,000 gallons per wheel. And this was without operating 24 hours a day. In addition, it was determined that it took only 30 gallons of water instead of the expected 40 to raise one gallon of

[1] *National Gazette* (July 1822).

water to the reservoir.[2] In other words, the water-powered system was a third again more efficient than had been projected[3].

In the minutes of its 31 Dec 1822 meeting, the Watering Committee expressed its gratitude toward Frederick Graff in that odd language typical of committees, at once understated and effusive:

> Mr. Graff merits the thanks of this Committee, and they are hereby tendered to him, for his judgment, prudence, indefatigable attention, and taste, in the management and prosecution of the works at Fairmount, to the period of their happy conclusion, owing largely to his exertions and skill; and also for his zealous attention to the general interests of the city, in all its concerns under his management.[4]

A few days later, the Watering Committee included official praise for Graff in its annual report to the Select and Common Councils:

> The Committee cannot close this Report, without presenting, in the most distinct manner, to the notice of both the Councils and the City, Mr. Frederick Graff, for many years Superintendent of the Water Works, whose taste in the design, and whose judgment in the arrangement, of the Works at Fair Mount, with his indefatigable zeal for the public interest, in every department, have attracted the regard and thanks of the Committee, and entitle him to those of the Councils.[5]

By 1824, the three wheels were together raising approximately three million gallons per day to the Fairmount Reservoir at a total cost of $3.70 per day.[6] The comparison with the steam

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[2] Watering Committee, *1822 Annual Report* (9 Jan 1823), 13f; and Watering Committee, *1823 Annual Report* (3 Jan 1823).
[3] This figure was derived by the calculation of 1/30 divided by 1/40.
[4] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 435.
[5] Watering Committee, *1822 Annual Report* (6 Jan 1823), 22.
[6] Watering Committee, *1824 Annual Report* (13 Jan 1825), published in *American Daily Advertiser* (Philadelphia: 20 Jan 1825). The amount was the equivalent of approximately $113 in 2022.

operation's cost of $206 per day[7] to raise 1.6 million gallons was stunning.

That same year, the City of Philadelphia and the Schuylkill Navigation Company renegotiated their agreement regarding Fairmount. On 14 June the City paid $26,000[8] for the right to all water beyond what was necessary for the operation of the navigation system, without further restriction. The City would also "have and take charge of the locks and canal."[9] What no one could know at the time was that in less than a decade the two parties would be involved in a contentious legal dispute over this agreement, the resolution of which would have serious and far-reaching repercussions for the long-term viability of water power at Fairmount.

For now, though, Philadelphia reveled in the success of its new water works. In 1828, with the system's operation well demonstrated, the Watering Committee presented Frederick Graff with a second silver vase in appreciation of his hard work and brilliant creativity. The inscription on the vase read:

> Presented by the Watering Committee of the city of Philadelphia, to Frederick Graff, Esq., Superintendent of the Water-works, as a testimonial of respect for his talents and zeal effectually displayed in overcoming unforeseen difficulties encountered in the construction of the northeast reservoir at Fairmount Water-works. Philadelphia, September 1st, 1828.[10]

While the Fairmount Water Works was wildly successful in providing both water and water power, and the locks made it possible to navigate the Schuylkill River, this did come at a cost that was more than monetary to those owning land fronting the river. The nature of the river

[7] The equivalent of approximately $6,290 in 2022.
[8] The equivalent of approximately $793,900 in 2022.
[9] Watering Committee, *1824 Annual Report* (13 Jan 1825), 4, 5f; John K. Kane, Opinion of the City Solicitor, 3 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 12f. See also Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and Watering Committee, *1852 Annual Report* (6 Jan 1853), 47. The price is the equivalent of over $663,400 in 2021 dollars.
[10] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (William Brotherhead, 1859), 436.

from Fairmount to East Falls changed dramatically upon the completion of Fairmount Dam in 1821. The water level rose considerably. What had been a rapidly flowing current was now more like a lake. Portions of properties along the river became permanently flooded; in some cases open fields became swamps.

The experience of Samuel Breck is one poignant example. A prominent Philadelphian, Breck had in 1797 built Sweetbriar, a mansion on land situated on the west bank of the Schuylkill River almost exactly one mile upstream of Fairmount Dam. Entries in his diary describe how he and his only daughter enjoyed watching construction of the dam and imagining how it would benefit the city. Later, however, he would write of the death of his daughter from typhoid fever at age 21 and ascribe her untimely passing to the unhealthy "miasma" caused by polluted river water flooding and destroying his meadows along the riverfront.[11]

Whether or not the death of Breck's daughter was connected to the changes in the Schuylkill River is debatable, of course, but what is certain is that the higher water level did cause irreparable harm to waterfront properties along both sides of the river for miles. The City of Philadelphia paid damage claims to landowners for years. In 1824 the Watering Committee reported:

> The Committee would hope, that as the damages have been generally settled with those who have in their opinion really suffered injury by the erection of the dam, that the sum to be paid hereafter will be small. Where lands of mills have been overflowed or backed upon, the Committee have promptly proceeded to do justice to the parties, either by a reference or by

[11] Nicholas B. Wainwright, Ed., *The Diary of Samuel Breck, 1814–1822* (Philadelphia: The Historical Society of Pennsylvania, Oct 1978), 469ff. A local merchant, philanthropist, essayist, and orator, Breck (1771–1862) was also a Federalist politician who pushed for the abolition of slavery, free education for the poor, and improvements to the state's transportation infrastructure. He served in the Pennsylvania House of Representatives from 1817 to 1820, in the U.S. House of Representatives from 1823 to 1825, and in the Pennsylvania Senate from 1832 to 1834. Breck's daughter Lucy died on 25 Jul 1828. See Nicholas B. Wainwright, Ed., *The Diary of Samuel Breck, 1827–1833* (Philadelphia: The Historical Society of Pennsylvania, Oct 1978), 229.

> compromise, and sometimes by both; but where claims have been made which in the opinion of counsel were not supported in law, they have been resisted, and will in all cases be decided by the proper tribunal. None of them have yet come to a hearing, though the Committee have thrown no difficulty in the way, but on the contrary, have facilitated their progress as much as was in their power.[12]

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Philadelphia in the early nineteenth century was a center of innovation, new ideas, new methods, and new products and services. It was a kind of Silicon Valley of the time. A growing engineering class was developing. The city was transitioning from an artisan economy to a nascent industrial one.

Water power was still an important source of energy, but steam was making an increasing contribution. Oliver Evans' high-pressure steam engine, smaller and more powerful than James Watt's low-pressure design, made steam a more manageable power source and helped drive the rise of industry. Steam-powered iron- and other metal-working establishments began to overtake the small shops producing handmade goods which had long been dominant. And because steam-operated facilities could be much more flexible in their location—they were not tied to particular geographic locations like water-powered facilities were—they could be sited much closer to both suppliers and customers. With a nucleus in the blocks north of Market Street from North 2nd to North 9th Streets, the area of the city from the docks at the Delaware River toward Centre Square was the first to become known for manufacturing. It was an area well known to Frederick Graff;

[12] Watering Committee, *1823 Annual Report* (8 Jan 1824), 4.

he lived with his wife and children in a house on the northwest corner of 10th and Cherry Streets,[13] seven blocks from his boyhood home on the southwest corner of 7th and Market Streets.[14]

A group of mechanics and engineers began gathering in a store on Market Street between 5th and 6th Streets[15] owned by Nathan Sellers, a local inventor and innovator.[16] Much could be learned from the men involved in designing, constructing, and operating machines who gathered to share their knowledge and experiences. They included Oliver Evans (early on), Isaac Lukens, Patrick Lyons from England, Jacob Perkins, John Agnew, and Samuel Vaughn Merrick.[17] They often traveled in each others' social circles. Occasionally their families even intermarried, as when James Rush, the brother of sculptor and Watering Committee member William Rush, married the daughter of Oliver Evans.[18] Frederick Graff would've known and interacted with these men professionally and benefited greatly from the cross-flow of ideas.

The commercial and industrial expansion fueled the city's population growth. Philadelphia's population was approximately 41,000 in 1800. The districts of Northern Liberties

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[13] Frederick Graff to Joseph Watson, Esq., (27 Sep 1827). In the letter Graff protests the granting of a continuation of a license for a new owner of a boarding house opposite his home. Twice weekly dances were attracting men who were causing disturbances and vandalizing neighboring property.

[14] "Memoir of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890); Thomas Westcott, *The Historic Mansions and Buildings of Philadelphia* (Philadelphia: Walter H. Barr, 1895), 307ff. This is the house in which Thomas Jefferson lodged while writing a draft of the Declaration of Independence during the summer of 1776. Graff was less than a year old at the time. Built by Graff's father in 1775, it was demolished in 1883 and was partially reconstructed by the federal government in 1975 for the Bicentennial celebration.

[15] Two blocks north of the Pennsylvania State House, today known as Independence Hall.

[16] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–40) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 89ff. During the revolutionary war Sellers had manufactured paper molds for producing currency. See Lyman Horace Weeks, *A History of Paper-Making in the United States, 1690–1916* (New York: 1916), 54ff.

[17] Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–40) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965).

[18] James I. Rush and Peter D. Muhlenberg ran Evans' firm as the Rush & Muhlenberg foundry after Evan's death in 1819. See Greville Bathe and Dorothy Bathe, *Oliver Evans* (Philadelphia: Historical Society of Pennsylvania, 1935), 232f, cited in Eugene S. Ferguson, ed., *Early Engineering Reminiscences (1815–40) of George Escol Sellers* (Washington, D.C.: Smithsonian Institution, 1965), 32n.46.

to the north and Southwark to the south together contained a little over 20,000.[19] In 1820 the population of the settled area of Philadelphia and the surrounding districts was nearly 110,000.[20] By 1840 the combined population was over 220,000.[21] As industry and population grew, of course, so did the need for water.

As Philadelphia's water consumption increased, Frederick Graff's foresight in creating an expandable design for the Fairmount Water Works proved its worth. He added wheel-and-pump sets incrementally in the Mill House spaces he had designed to receive them.

Wheel No. 4 became operational on 10 Nov 1827, adding its power to the original three.[22] Instead of constructing it entirely of wood (excepting the iron shafts) like its predecessors, Graff introduced an innovative composite design of his own creation,[23] composed of nearly all cast and wrought iron, with the buckets alone made of wood. The iron was expected to last longer in the high-moisture environment in which the wheel operated before it needed replacement or extensive refurbishment.[24] The wheel and the pump were both made by Rush & Muhlenberg,[25] who found that the cost of producing the wheel exceeded the agreed-upon

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[19] U.S. Census Bureau, *Population of the 33 Urban Places: 1800,* <https://www.census.gov/population/www/documentation/twps0027/tab03.txt>, 15 Jun 1998, accessed 31 Jan 2019.

[20] U.S. Census Bureau, *Population of the 61 Urban Places: 1820,* <https://www.census.gov/population/www/documentation/twps0027/tab05.txt>, 15 Jun 1998, accessed 31 Jan 2019. Includes Spring Garden and Kensington neighborhoods.

[21] U.S. Census Bureau, *Population of the 100 Urban Places: 1840,* <https://www.census.gov/population/www/documentation/twps0027/tab07.txt>, 15 Jun 1998, accessed 31 Jan 2019. Includes Spring Garden, Kensington, and Moyamensing neighborhoods.

[22] Watering Committee, *1827 Annual Report* (10 Jan 1828), 5, and Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 (*Statistics Relating to Fairmount Water Works*).

[23] Frederick Graff to the Select and Common Councils of the City of Philadelphia (17 Apr 1833), 10.

[24] In this regard, the new wheel design would need to pass a high standard. The first three, all-wood wheels would see service for 24 continuous years before they were replaced in 1846. In the end, the composite wheels did indeed out-perform the wood wheels. All of the initial iron-and-wood wheels would serve continuously for between 27 and 42 years (with an average of 34.4 years) before they were all replaced by an entirely new system.

[25] Contract for Water Wheel, *City of Philadelphia Archives.* The contract proposal was dated 28 Aug 1826; the contract was finalized 3 Oct 1826. From the agreement: "We will make and put up at Fair Mount Water Works a water wheel to be eighteen feet in diameter to the extreme of the buckets, and fifteen feet long, the socets [*sic*] and rime [*sic*] four in number and the arms for which are to be cast iron, then together with all the work to be connected therewith embracing castings of iron, and of brass together with all the wrought iron bolts, railings, partitions,

contract payment. It seems there was a negotiated settlement for reimbursement of the cost overrun. The Watering Committee originally contracted to pay $4,500[26] for delivery and installation of the wheel and $3,667[27] for the pump. After the wheel was produced, Rush & Muhlenberg requested an additional $669[28] but in the end the Watering Committee only paid another $95[29] "for extra work not in the contract."[30]

Wheel No. 4 was 15 feet wide and 18 feet diameter,[31] and weighed 22 tons.[32] It ran at 11 rpm, pumping 121.4 gallons with each revolution. The four wheels together had the ability to keep the Fairmount Reservoir continuously full. When floods occurred the advantage of a large reservoir was amply demonstrated; the wheels were stopped to allow the turbid floodwaters to pass by, while the city was supplied in the meantime with clearer water from the reservoir.

Wheel No. 5, a duplicate of Wheel No. 4, entered service on 5 Apr 1832.[33] The wheel and its pump were both produced by the Levi Morris & Co. foundry for $4,430 and $3,100, respectively.[34] Wheel No. 6, the same in composition and width as numbers 4 and 5, was two feet smaller in diameter; it began service on 5 Nov 1834.[35] Levi Morris delivered the wheel and its pump for a combined $7,900.00.[36]

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linings, flumes, gates, gearings, and every other part of said work necessary to be done in the space comprehended from the north line of the north wall of the wheel pit, to the extreme of the crank wheel and crank pin at the south end of said wheel, and between the walls of the east and west of the building including the enclosure on the west side of the wheel."

[26] The equivalent of approximately $133,300 in 2022.

[27] The equivalent of approximately $108,600 in 2022.

[28] Rush & Muhlenberg to Watering Committee, 12 Nov 1827, *City of Philadelphia Archives*. The amount was the equivalent of approximately $19,800 in 2022.

[29] The equivalent of approximately $2,800 in 2022.

[30] Watering Committee, *1827 Annual Report* (10 Jan 1828).

[31] Watering Committee, *1827 Annual Report* (10 Jan 1828), 5; and Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 24.

[32] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 24.

[33] Watering Committee, *1852 Annual Report* (6 Jan 1853), 32f.

[34] Levi Morris to Frederick Graff, 14 Mar 1831, *City of Philadelphia Archives*. The amounts were the equivalent of approximately $152,600 and $106,800 in 2022.

[35] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 24.

[36] Contract with Levi Morris & Co. (Levi Morris & Isaac P. Morris), *City of Philadelphia Archives*, 25 Mar 1834. The amount was the equivalent of approximately $272,000 in 2022.

The last two breast wheels to begin operational service, Nos. 7 and 8, were again of composite design (cast and wrought iron, with wood buckets) and began operating together on 24 Aug 1843.[37] The Merrick & Towne foundry supplied both wheels and their pumps for a combined $15,000.[38] The Mill House was for the first time now fully built out. The following year, a correspondent for the *Public Ledger,* a local newspaper, praised Graff's prudence in designing the system to be expandable:

> It is worthy of remark that, although the plans…were made twenty years ago, (when such works were unknown in this country,) all the provisions then made for anticipated contingencies that have come into use, and have proved full and sufficient for the objects for which they were prepared; showing the foresight and talent of the Engineer, Frederick Graff, Esq., who, with superior skill, economy, and disinterestedness [lack of selfish motives], designed every part of the structures which have been so eminently useful to Philadelphia, and indeed to numerous other cities and towns in the United States; for, as the first work of its kind, it has been imitated by so many that it may aptly be styled "the father of them all."[39]

As much of an advance as the system of breast wheels represented over the two early steam engines in terms of safety and operating costs, they did suffer one disadvantage. Up to Fairmount Dam the Schuylkill River is tidal. Its level rises and falls, cycling approximately twice a day on average. When the tide was low, the breast wheels operated well. As the tide rose past the level of 16 inches above the bottom of the breast wheels, however, the wheels slowed and eventually stopped, restarting and coming up to speed again as the tide receded. For each tidal cycle the breast wheels gradually slowed for about 1½ hours, were completely stopped for about an hour, and took about 1½ hours to slowly come back up to full speed. Since there was an

[37] Watering Committee, *1852 Annual Report* (6 Jan 1853), 32f.
[38] The equivalent of approximately $600,300 in 2022.
[39] *Public Ledger* (Philadelphia, Pennsylvania: Tuesday, 25 Jun 1844), 1.

average of two tidal cycles per day, each day the wheels were completely stopped for two hours and were slowed for six.[40] As demand for water increased, eventually requiring continuous operation, this would emerge as a significant drawback.

By 1844 the first three wheels—constructed entirely of wood and installed in 1822 when the water-powered system began operating—had become dilapidated and their stone breastwork was worn.[41] The three wheels had to be extensively refurbished once already, eleven years earlier.[42] The routine thing would've been to replace them with similar breast wheels. Frederick Graff, however, was always alert to technological developments in waterpower systems. In 1842 and 1843 the Franklin Institute, a new technical training organization, published articles by Elwood Morris about a new device called a turbine. Developed by French engineer Benoît Fourneyron (1802–1867) and improved by another Frenchman, Feu Jonval,[43] the turbine held the promise of greater efficiency and would not be slowed or stopped by the twice daily high tides. With certain modifications it might even work when completely submerged during flood events. Graff and his son were intrigued by the concept.

In the Annual Report for 1843, Watering Committee Chairman John Price Wetherill,

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[40] Watering Committee, *1822 Annual Report* (4 Jan 1844), 7; Watering Committee, *1845 Annual Report* (8 Jan 1846), 12. The Annual Report indicates an average stoppage of approximately 64 hours per month.

[41] Watering Committee, *1843 Annual Report* (4 Jan 1844), 7; Watering Committee, *1845 Annual Report* (8 Jan 1846), 5.

[42] Watering Committee, *1832 Annual Report* (14 Feb 1833), published in *Hazard's Register of Pennsylvania,* Vol. XI (Jan–Jul 1833), 171 (rendered as page 181 due to typographical error).

[43] Elwood Morris, "Remarks on Reaction Water Wheels Used in the United States and on the Turbine of M. Fourneyron," *Journal of the Franklin Institute,* Vol. 34 (Oct 1842), 217ff, (Nov 1842), 289ff; Elwood Morris, "On the Frictional Dynamometer, or Brake, of M. de Prony, a Cheap, Simple, and Effective Instrument, for Measuring the Actual Power Developed by Machines," *Journal of the Franklin Institute,* Vol. 35 (1843), 225ff; Elwood Morris, "Experiments on the Useful Effect of Turbines in the United States," *Journal of the Franklin Institute,* Vol. 36 (Nov 1843), 377ff; and Elwood Morris, trans., "Experiments on Water-Wheels, having a vertical axis, called Turbines, by Arthur Morin, Captain of Artillery, Professor of Machinery in the School of Artillery, etc., etc.," Vol. 36 (Oct 1843), 234ff, (Nov 1843), 289ff, and (Dec 1843), 370ff. Quoted and cited variously in Edward T. Layton, Jr., "Scientific Technology, 1845–1900: The Hydraulic Turbine and the Origins of American Industrial Research," *Technology and Culture*, Vol. 20, No. 1 (Jan 1979), 70n21; Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute 1824–1865* (Baltimore and London: The Johns Hopkins University Press, 1974), 322f, 322n40; Edward W. Constant, "Scientific Theory and Technological Testability: Science, Dynamometers, and Water Turbines in the 19th Century," *Technology and Culture,* Vol. 24, No. 2 (Apr 1983), 188f, 189n25, 190f, 191n31.

channeling Graff, wrote:

> Since [1822], wheels of a different construction from those at Fair Mount have been built at the cotton mills of Messrs. Youngs, and at the powder-mills of Mr. DuPont, in Delaware State. After a fair trial, those gentlemen agree in opinion, that their new wheels have great advantages over those in common use, not only in the saving of water, but also by not being impeded by back water, which, at our works, is an important consideration, particularly as our wheels are often stopped by the tides six hours in twenty-four. The turbine-wheels can be worked even in times of freshets, without intermission, with only slight loss of power, when the water is unusually high. The character given to these wheels, with the favorable opinion of persons who have them in use, has induced your Committee to recommend the trial of one, which they propose to place in the chamber of the old wheel, No. 1, which is entirely worn out, in the mean time, to have partially repaired the wheels, Nos. 2 and 3, until the turbine shall be fairly tested…[44]

Since Wheel No. 1 needed to be replaced in any event, in April of 1844 Graff sent to two manufacturers—Merrick & Towne and I. P. Morris & Co.—a request for proposals for the fabrication and installation of a turbine.[45] Merrick & Towne, with whom Elwood Morris was associated, responded with a competitive bid a month later. Graff recommended replacing Wheel No. 1 with a turbine and evaluating it to see how well it worked. Until the turbine's performance could be determined, he recommended the repair of Wheels 2 and 3. Graff estimated the combined cost of the turbine and partial repair of the two wheels to be $8,000.[46]

[44] Watering Committee, *1843 Annual Report* (4 Jan 1844), 7.
[45] Frederick Graff to Merrick & Towne and I. P. Morris & Co., 4 Apr 1844. City of Philadelphia Archives. See also Unsigned Contract, 1844, City of Philadelphia Archives, cited in Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 89n.19. The latter document includes the plan of a turbine placed in the Mill House space for Wheel No. 1 and operating the existing pump.
[46] Watering Committee, *1843 Annual Report* (4 Jan 1844), 7. The amount was the equivalent of approximately $315,900 in 2022.

By the end of 1844, however, the Watering Committee decided against installing a turbine after all. In the intervening time since Graff and Wetherill had recommended testing a turbine at Fairmount, false information regarding turbine installations upriver at the Flat Rock Dam and at the Crane Iron Works in Catasauqua near Allentown, Pennsylvania—that they were less efficient than the breast wheel systems they replaced[47]—made the Committee skittish. It didn't help when Edward Heston, a millwright who had worked on the installation and repairs of some of the breast wheels at Fairmount, advised Graff, possibly out of self-interest,[48] to continue with the original setup. He stated erroneously that "your pumps cannot be geared to a Turbine so as to make a permanent substantial fixture, and would be also subject to considerable repairs and consequently loss of time."[49] Instead of experimenting with innovation, this time the Watering Committee decided to go with the tried-and-true, specifically citing the phantom gearing issue as a reason:

> …your Committee, on further consideration, deemed it expedient to suspend the building of the Turbine-wheel in order to obtain a more decisive opinion of that kind of power from those who were about erecting such wheels. Since then, two large "Turbines" have been put in operation on the Lehigh River [at the Crane Iron Works], they are said to work exceedingly well, but from the necessary geering [*sic*] required to adapt these wheels to pumping, your Committee have concluded to abandon the erection of a Turbine…[50]

The Committee decided to take the $8,000 it had requested for a turbine and repair of two wheels and instead use it on simply replacing the first three wheels with composite designs similar to Wheels Nos. 7 and 8, cast iron with wood buckets.[51]

[47] Frederick Graff to Alfred V. du Pont, Esq., 27 May 1845. Hagley Museum.
[48] Water Department, *Chief Engineer's 1859 Annual Report,* 9 Feb 1860, 23f.
[49] Edward Heston to Frederick Graff, 16 Feb 1844. City Archives.
[50] Watering Committee, *1844 Annual Report* (2 Jan 1845), 5.
[51] Watering Committee, *1844 Annual Report* (2 Jan 1845), 5f.

Graff later complained in a letter to his friend Alfred V. du Pont:

> Since our correspondence some time ago, on the subject of placing a Turbine at Fair Mount, our Committee have faltered, and still have me tinkering with the old breast wheels…[52]

City Councils, however, had not yet actually appropriated the $8,000; in 1845 they gave the Watering Committee only $5,000 for the wheels instead.[53] Since this was not enough to pay for the replacement of all three wheels, the Committee was forced to economize and temporarily repaired the wheels as a stop-gap measure. In 1846 Councils finally appropriated enough funds to replace all three wheels. They were replaced in kind, however, with an all-wood design,[54] not the composite design of Wheels 7 and 8 as the Watering Committee had intended. Identical in dimension to each of the originals,[55] the wheels were produced by I.P. Morris & Co.[56] for $14,545 altogether.[57] The replacements for Wheels No. 1 & 2 both began operating on 15 July 1846. The final breast wheel to be installed at the Fairmount Water Works, the replacement for Wheel No. 3, began operating on 27 Aug 1846,[58] by coincidence Frederick Graff's 72nd birthday. Table 4-1 provides a summary comparison of the breast wheels in the Mill House.

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[52] Frederick Graff to Alfred V. du Pont, Esq., 27 May 1845. Hagley Museum. Alfred V. du Pont (1798–1856) was the oldest son and successor of Éleuthère Irénée du Pont, the founder of E.I. du Pont de Nemours and Company.
[53] The equivalent of approximately $194,800 in 2022.
[54] Watering Committee, *1846 Annual Report* (14 Jan 1847), 6; *City of Philadelphia Archives*. Graff had written a proposal for a composite replacement for Wheel No. 1 in early 1845, but it was never completed. On 4 Mar 1845, a proposal for an all-wood wheel was published and bids were accepted.
[55] Watering Committee, *1852 Annual Report* (6 Jan 1853), 32ff.
[56] Watering Committee, *1846 Annual Report* (14 Jan 1847), 6.
[57] The equivalent of approximately $559,500 in 2022.
[58] Watering Committee, *1846 Annual Report* (14 Jan 1847), 6; Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 (*Statistics Relating to Fairmount Water Works*); Watering Committee, *1852 Annual Report* (6 Jan 1853), 48. Although the *1849 AR* and *1852 AR* both indicate all three replacement wheels began operating 14 Jul 1846, the *1846 AR* specifies replacement Wheels No. 1&2 began operating 15 Jul 1846 and replacement Wheel No. 3 began operating 27 Aug 1846.

Table 4-1. Comparison of the breast wheels installed in the (Old) Mill House, Fairmount Water Works.

Breast Wheel	***Date Operational***	***Material***	***Dimensions***	***Manufacturer***	***Date Replaced***	***Replacement Material***	***Manufacturer***
1	1 Jul 1822	wood	15 ft. diam. 15 ft. wide	Oaks & Bromley	15 Jul 1846	wood	I.P. Morris
2	14 Sep 1822	wood	16 ft. diam. 15 ft. wide	Oaks & Bromley	15 Jul 1846	wood	I.P. Morris
3	24 Dec 1822	wood	16 ft. diam. 15 ft. wide	Oaks & Bromley	27 Aug 1846	wood	I.P. Morris
4	10 Nov 1827	iron, with wood buckets	18 ft. diam. 15 ft. wide	Rush & Muhlenberg	—	—	—
5	5 Apr 1832	iron, with wood buckets	18 ft. diam. 15 ft. wide	Levi Morris	—	—	—
6	5 Nov 1834	iron, with wood buckets	16 ft. diam. 15 ft. wide	Levi Morris	—	—	—
7	24 Aug 1843	iron, with wood buckets	18 ft. diam. 15 ft. wide	Merrick & Towne	—	—	—
8	24 Aug 1843	iron, with wood buckets	18 ft. diam. 15 ft. wide	Merrick & Towne	—	—	—

At the time of the startup of the initial water-powered system in 1822, Fairmount Reservoir consisted of two basins but the space atop Fairmount allowed the reservoir to be enlarged as needed. The original reservoir, Basin No. 1, had been completed in 1815. It had a capacity of approximately 3.9 million gallons and was partitioned into two cells. From 1815 to 1822, water was pumped directly from either of the steam engines in the Engine House into this basin and from there the water flowed into the distribution system. Basin No. 2, completed in 1821, received water directly from the Mill House when the water-powered facility took over from the steam engines in 1822. Water was then pumped to Basin No. 2 via a separate ascending main from each of the Mill House's wheel-and-pump sets. The basin had a capacity of approximately 3.3 million gallons and was connected to Basin No. 1 by two 20-inch cast iron

pipes. Basin No. 3 was completed in 1827 with a capacity of approximately 2.7 million gallons. Basin No. 4 was divided into three cells; one cell was completed in 1835[59] and the other two were completed in 1836.[60] Together, the three cells of Basin No. 4 had a capacity of approximately 12.1 million gallons. When the four-basin complex was completed in 1836, the built-out Fairmount Reservoir had a total capacity of a little over 22 million gallons.

One of the advantages of having the reservoir divided into multiple basins was that any one of the basins or cells could be closed and drained for cleaning or repairs without shutting down the entire system. Table 4-2 provides a summary comparison of the the basins which together comprised the Fairmount Reservoir.

Table 4-2. Comparison of the basins of Fairmount Reservoir.[a]

Basin	Year Completed	Capacity (gallons)	Construction Cost ($)
1A/B	1815	3,917,659	32,508.52
2	1821	3,296,434	9,579.47
3	1827	2,707,295	24,521.75
4A	1835	3,658,016	
4B	1836	4,381,322	67,214.68
4C	1836	4,071,250	
TOTAL WHEN BUILT OUT:		22,031,976	133,824.42

a. *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 25f; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 25.

In 1841, the average daily consumption was between 3.1 million and 5.6 million gallons, depending upon the time of year.[61] This meant that there was now an approximate reserve capacity of between four and seven days' worth of water in the reservoir at any given time, an

[59] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 26.
[60] Watering Committee, *1836 Annual Report* (5 Jan 1837), 16.
[61] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 42.

improvement upon the 3½ days' reserve during the time of steam operations at Fairmount.

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In the years following the debut of water-powered operations at the Fairmount Water Works in 1822, Graff continued to replace wood mains and pipes with cast iron. In 1829, he ran a second 20-inch main from Fairmount Reservoir, this one heading south under Callowhill Street to connect with the distribution system at Chestnut Street and Schuylkill 8th Street (today called 15th Street).[62] In 1832, he pulled up 2,450 feet of cast iron main which had been laid along the unfinished Union Canal bank in 1820[63] and replaced it a with cast iron main along the Columbia Railroad from Hunter Street to Schuylkill 2nd Street (today's 23rd Street), near Callowhill Street.[64]

The Watering Committee began replacing wood mains with iron at a rapid pace, although it did continue to install wood on some minor side streets and alleys—mostly where original wood mains needed repair but were not yet programmed for replacement.[65] Between 1822 and 1838, over 10,000 feet of cast iron main was laid each year but two, peaking with 41,000 feet in 1827.[66] Repair of wood mains ended in 1832.[67]

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[62] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 29. Unlike the earlier connector mains, this main bypassed the below-ground cast-iron distribution chest at the Centre Square engine house. The building was demolished the same year.
[63] Watering Committee, *1822 Annual Report* (9 Jan 1823), 18; and *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 28.
[64] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 28f.
[65] For example, 850 feet of wood mains were installed in 1830, 1,131 feet in 1831, and 220 feet in 1832 for this reason. See Watering Committee, *1830 Annual Report* (10 Feb 1831); Watering Committee, *1832 Annual Report* (14 Feb 1833).
[66] Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 45.
[67] Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 45; Watering Committee, *1858 Annual Report* (12 Jan 1859), 18.

In 1819, when cast iron mains began to be laid, there were approximately 32 miles of wood mains and pipes in use. By 1842, over 113 miles of cast iron pipe had been installed and the length of wood mains had dropped to only three miles.[68] Despite the large amount of resources focused on replacing the wood mains, however, it would take until 1848 to convert just the mains under the principal streets east of Broad Street.[69] Replacement of all wood mains with iron wouldn't be accomplished until 1858.[70]

The built-in expandability of the water-powered system at the Fairmount Water Works allowed the operation to more than keep up with demand. In 1823 Fairmount produced an average of 1,616,160 ale gallons of water per day. Expenses for the year were $69,268[71] and revenue from water rents were $26,013,[72] making a deficit of $43,255.[73] While expenses rose and fell depending on work which may have needed to be done in any given year, revenue consistently increased. Eventually the system became a money-maker for the City. Revenue outpaced expenses by 1830; that year a net profit of $33,258 was realized.[74]

It had been customary for the Watering Committee to request funding from City Councils in its Annual Report each year, but this had changed when the waterpower system proved to be so successful. In 1831 the Committee got ahead of itself and boasted to Councils that it would no longer need present a proposal of means to cover estimated expenses for the coming year, because Fairmount was generating more funds than it spent. The Watering Committee reported:

> It has been usual, in former reports, to present a conjectural statement of the means likely to be applicable to the expenditure of the current year, and the committee would continue this

[68] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 29.
[69] Watering Committee, *1848 Annual Report* (4 Jan 1849), 6.
[70] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 18.
[71] The equivalent of approximately $1.95 million in 2022.
[72] The equivalent of approximately $733,700 in 2022.
[73] The equivalent of approximately $1.22 million in 2022.
[74] The equivalent of approximately $1.07 million in 2022.

> practice, if they supposed that any benefit could result from it; but when they consider, that, be the expenditure of any year what it may, the income of that year will exceed it, they dispense with hypothetical calculation as of no practical utility.[75]

In fact, two years later expenses outran revenue once more, but after that Fairmount turned a profit every year until at least 1851. The highest profit was $121,788,[76] realized in 1844. By 1851 Fairmount was producing an average of 5,690,774 ale gallons per day.[77] Fairmount Water Works was paying for itself and then some.

By 1835 the number of customers supplied with water in the city rose to 10,059 and public hydrants supplied water for an additional 3,000. The number of customers supplied in the surrounding districts was 5,645, bringing the total to 18,704. The average rent was $5.34;[78] the average daily supply of water to each customer was 187 gallons. In the Annual Report for that year Graff favorably compared these figures with the British city of London where 199,493 customers each received an average daily supply of 180 gallons of at the cost of $6.69[79] to each customer.[80]

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In July 1824 a celebration was held for the official opening of the Reading to Pottsgrove portion of the Schuylkill Navigation system. Frederic Graff was invited to participate in the

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[75] Watering Committee, *1830 Annual Report* (Jan 1831), published in *The Register of Pennsylvania,* Vol. VII, No. 12 (Philadelphia: 19 Mar 1831), 187.
[76] The equivalent of approximately $4.8 million in 2022.
[77] Watering Committee, *1851 Annual Report* (1852); cited in Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978),41ff.
[78] The equivalent of approximately $179.72 in 2022.
[79] The equivalent of approximately $225.16 in 2022.
[80] Watering Committee, *1835 Annual Report* (28 Jan 1836), 14.

festivities and he later described the occasion to his wife Judith. An excerpt from Graff's letter provides a sense of the good humor with which he viewed the world:

> July 3—You must not be astonished when I inform you that I shall start tomorrow for Reading. The Committee was invited to go up to the canal to join in the celebration of opening it on the 5th of July and I of course must you know form one of the party otherwise the Water would not run—hrr [chuckling]—There is to be a grand procession of boats, flags, etc, etc. to pass down the canal from Lewis's falls to Pottsgrove where we will again take carriage and proceed on our way home.
>
> July 6—I left Phila on Saturday July 3rd for Reading where we arrived in the evening and found people from every quarter collecting for the purpose of celebrating the opening of the canal. On Sunday we rode 10 miles up the works to view them, and on this morning at 3 o'clock the great gun called us to quarters, at 5 we breakfasted and at 6 all hands were called to quarters, our fleet was arranged in the following manner. The boat Thomas Oakes carried Governor [Hiester], who wishes to be remembered to Mr. Trevor & Father, part of the navigation company, part of the Councils of Philadelphia, the Engineer of the works and some other worthies including his honour your Husband who had the honor to command the flag representing a boat passing over an aqueduct of the canal. The first boat was manned with 36 persons. Next came the boat Stephen Girard manned with 120 Ladies and Gentlemen of Reading with flutes, clarinet, etc, etc. Then came the Chancellor Livingston manned with the friends generally of the company and the artisans of the works, when all was arranged the Commodore gave orders for the fleet to [pass] under a heavy salute from the shore. We glided joyfully down the stream making the mountains smile at our glorious enjoyment. After passing about two miles a signal was given for the fleet to close in, when an oration on the occasion was given by Mr. Charles Evans of Reading. We then proceeded 4 miles further and entered the canal. After a repast the horses were hitched too [*sic*] and we glided along this

> great work with salutes from all quarters by the country friends, some of which only a day before said a boat would never pass. After going on to Laural [*sic*] Hill a distance of about 12 miles we halted. The Pottsgrove volunteers were ready to receive us and saluted in stile [*sic*]. We here parted with our friends, jumped in our carriages which were in waiting and passed on to Norristown at which place we arrived at 9 at night, started again early this morning, arrived home at 11 o'clock and had the great pleasure of finding the children all in fine order and health.[81]

This era is often thought of today as a so-called golden age of operation for the Fairmount Water Works. Even golden ages have their difficulties, however. Despite its great success, the Watering Committee had to defend Fairmount against more than a few threats to its effectiveness.

One seemingly minor issue ended up requiring Frederick Graff to personally travel to the state capital in Harrisburg. Although the property at Fairmount was owned by the City of Philadelphia, it was physically located in the neighboring municipality of Spring Garden immediately to the north. In 1828 the Watering Committee got wind that the Spring Garden commissioners were planning to construct streets through the City-owned Fairmount property. When the local officials refused to back down, the Mayor and City Councils on 11 Dec sent to the state legislature a formal request for preemptive legislation to prevent the plans from being carried out.[82] Graff met with lawmakers over several days on behalf of the City. Graff found it very frustrating to have to argue their case before people who knew little or nothing of the issues involved. From Harrisburg he wrote to his wife, "The rascals from the county whom we treated

[81] Frederick Graff to Judith Swyer Graff (3 and 6 Jul 1824), Historical Society of Pennsylvania.
[82] *Journal of the House of Representatives*, 1828–1829 Session, 44; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93, 302n.67.

so well at F. Mount are all against us, in fact they are a set of cut throats."[83] Two days later he penned, "When I last wrote to you I did expect that our bill would have been brought up yesterday but alas instead of hearing some arguments in favour of Fair Mount I was obliged to sit and listen to a sett [*sic*] of Nincompoops from the woods arguing what is best to injure Philadelphia. I say injure, because they have not judgment to do it a service…"[84] Regarding politicians, the well-known French saying seems evergreen: *Plus ça change, plus c'est la même chose.* "The more things change, the more they stay the same."[85]

Frustrated or no, Graff was successful. On 13 Feb 1829 the legislature passed a law prohibiting any party from constructing any type of roadway through the Fairmount Water Works property.[86] During the same session, the legislature even inserted wording into the charter of a new railroad enjoining it from passing through the Fairmount property.[87]

Within a year, however, Graff found himself battling against another potential hazard. The managers of the Philadelphia and Columbia Railroad, part of the partially state-funded Main Line of Public Works, decided that instead of crossing the Schuylkill River at Peters' Island, two miles upstream, they wanted the rail line to cross the Schuylkill River directly on the southern side of the Fairmount Water Works property.

Graff contended that the piers for the railroad bridge would cause so much debris or ice

[83] Frederick Graff to Judith Sawer Graff, 1 Feb 1829, Mrs. Charles Graff Collection, Historical Society of Philadelphia.
[84] Frederick Graff to Judith Sawer Graff, 3 Feb 1829, Mrs. Charles Graff Collection, Historical Society of Philadelphia.
[85] Jean-Baptiste Alphonse Karr, *Les Guêpes*, July 1848.
[86] Laws of Pennsylvania, 1828–1829 Session, no. 33; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 94, 302n.70. See also Watering Committee, *1831 Annual Report* (12 Jan 1832); and Watering Committee, *1852 Annual Report* (6 Jan 1853), 47. The text of the law is included in the Annual Report for 1831.
[87] Laws of Pennsylvania, 1828–1829 Session, no. 172; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 94, 302n.71. The charter was for the Northern Liberties and Penn Township Rail Road Company, which planned to build a railroad from the Philadelphia and Columbia Railroad on the west side of the Schuylkill River (the easternmost portion of the Commonwealth of Pennsylvania's Main Line of Public Works) with the Delaware River.

to collect during freshets that flooding would be worsened and the time it took for floodwaters to recede would be lengthened, thereby causing the Fairmount Water Works to shut down for so long during these events that the health and safety of the entire city would be threatened.[88] Although there was currently a bridge across the Schuylkill just below Fairmount—the renowned Upper Ferry Bridge, known also as The Colossus—it had a single clear span across the river. The Colossus had no mid-structure piers which might catch debris and obstruct the flow of water away from the water works. City Councils sent unanimous resolutions to Harrisburg explaining the dangers of allowing a railroad bridge to be built so close to the water works; the legislature eventually gave in.[89]

The Schuylkill River below Fairmount, though not as active as the Delaware, was nevertheless a commercial river. A proposal was floated in 1834 for a Western Canal extending southward from the Schuylkill Navigation Company locks at the Fairmount Dam approximately 2½ miles along the west side of the river.[90] The project would have created numerous docks along an enclosed basin protected from the fluctuating tide. It was patterned after the West India Docks on the north side of the River Thames in London (today part of the redeveloped Canary Wharf area).

The problem with the proposed canal and basin was that all of its water—eight million gallons per day, according to the Watering Committee's estimate—would need to be drawn from

[88] Graff to Thomas Hale, Esq., 26 Dec 1829, collection of the Wintertur Museum. See also Watering Committee, *Report of the Watering Committee to the Select and Common Councils of Philadelphia, Relative to the Termination of the Columbia and Philadelphia Rail Road* (Philadelphia: Lydia R. Bailey, 1830), 15f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 94, 302n.72.
[89] Watering Committee, *Report of the Watering Committee to the Select and Common Councils of Philadelphia, Relative to the Termination of the Columbia and Philadelphia Rail Road* (Philadelphia: Lydia R. Bailey, 1830), 15f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 94, 302n.74.
[90] Watering Committee, *1836 Annual Report* (5 Jan 1837), 20.

the pool above the Fairmount Dam.[91] The great diversion of water would have jeopardized the viability of the Fairmount Water Works. In response to a request for information by City Councils, Watering Committee Chairman John Price Wetherill wrote in December 1834:

> …should the contemplated canal be constructed, that there is not a sufficient quantity of water in dry seasons for the operation of the works at Fair Mount, the Schuylkill Navigation Company and the canal in question…. Under every view of this important question, the committee are decidedly of the opinion that the proposed canal, if carried into effect, will increase the scarcity of water at Fair Mount, and under existing agreements between the Schuylkill Navigation Company and the City, be the means of stopping the works altogether.[92]

The City's opposition to the Western Canal would probably have surprised the casual observer. Just ten years prior, two projects which would have diverted massive amounts of water from the Fairmount pool were backed by the City of Philadelphia. Both proposals were seen as ways to use surplus waterpower to recoup for the City some of the expense of building the water works. In fact the City of Philadelphia had purchased the complete water rights at Fairmount from the Schuylkill Navigation Company in 1824 with an eye toward doing just that.

One idea had been to extend the Mill House's Forebay to the south, past the Engine House, and build factories on the east bank of the Schuylkill River. This would provide the City with the opportunity to make money by selling water power to the factory owners. Graff had made several drawings showing the Engine House replaced by a row of factory buildings.[93] On

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[91] Watering Committee, *1836 Annual Report* (5 Jan 1837), 20.
[92] John Price Wetherill to the Select and Common Councils of het city of Philadelphia (Dec 1834), published in *Philadelphia Gazette* (26 Dec 1834); subsequently published in *Hazard's Register of Pennsylvania,* Vol. XV (Jan 1835 to Jul 1835), 13.
[93] James F. O'Gorman, et al., *Drawing Toward Building: Philadelphia Architectural Graphics, 1732–1986* (Philadelphia: University of Pennsylvania Press for Pennsylvania Academy of the Fine Arts, 1986), Plate 2, opp. 116, text at 20.

19 May 1825 Graff estimated the canal and factory arrangement would generate for the City an annual profit of at least $6,440.[94]

An even more ambitious proposal had involved constructing a canal from Fairmount clear across the city to the Delaware River. The opening of the Erie Canal in 1825 represented a potentially devastating drawing of shipping and related commerce away from the city to the New York market. Business interests in Philadelphia began to push even harder than before for increased "internal improvements," mostly transportation infrastructure, within the Commonwealth of Pennsylvania so that they would be able to compete successfully. Numerous canal proposals were a large part of the suggested improvements.[95]

One of these proposals was a waterway connecting the Schuylkill River with the Delaware River by extending the proposed power canal from the Forebay. Plans were submitted by two of the country's leading engineers, Benjamin and Canvass White on 25 Jun 1825. Two routings were considered for the canal. The northern alternative passed by the south side of the Fairmount Reservoir then headed due east along Callowhill Street to Northern Liberties. From there it followed the bed of Peg's Run to the Delaware River, a distance of about two and three quarter miles. The southern route followed the east bank of the Schuylkill River to a point between Spruce and Pine Streets before crossing the city in a southeasterly direction to connect with the Delaware near Wharton Street, below the Navy Yard in Southwark, a distance of about four and a quarter miles. The northern route involved seven locks and had an estimated cost of $189,540;[96] the southern route had only one lock and was projected to cost $194,758.[97] With

[94] The equivalent of approximately $192,700 in 2022.
[95] Samuel Breck, *Sketch of the Internal Improvements Already Made by Pennsylvania* (Philadelphia: M. Thomas, 1818).
[96] The equivalent of approximately $5.7 million in 2022.
[97] The equivalent of approximately $5.8 million in 2022.

either alternative the expectation was that the locks would be in use twelve of every twenty-four hours and twelve boats would pass every hour of operation. The amount of water needed daily was estimated at 1,212,000 cubic feet (or approximately 9,066,390 gallons).[98]

By connecting the Delaware River seaport with the Schuylkill River just above Fairmount Dam, the proposed canal would've provided an alternative to the Erie Canal for shipping into the interior of the country through Pennsylvania via the Main Line of Public Works, a system of partly state-funded canals and railroads (including the Schuylkill Navigation system, Union Canal, Allegheny Portage Railroad, and Philadelphia and Columbia Railroad) linking Philadelphia and the Delaware River with the Mississippi River and Lake Erie.

Both the factory canal and connector canal proposals soon ran into trouble, however. While the landowners at Fairmount had sold to the City the land for the Fairmount Water Works and Reservoir, they wished to preserve their right to construct boat landings near the east end of the Mound Dam portion of Fairmount Dam and objected to the construction of a canal as an extension of the Forebay. A court pointed out that the rights to the Schuylkill River water had been granted and sold to the City of Philadelphia specifically to supply water for its citizens and that the City was forbidden to use the water for any profit-making activity. The idea of a canal was abandoned in 1829.

In any event, the Watering Committee and City of Philadelphia now in 1834 opposed the Western Canal proposal. With twelve years of experience operating the Fairmount Water Works under their belts, Graff and the members of the Watering Committee now knew better than to expect that there would be an excess in the supply of water forever. Wet and dry periods,

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[98] *Report of the Watering Committee, on the Disposal of the Surplus Water Power of the River Schuylkill, and the Construction of a Canal between the Schuylkill and Delaware* (July 1825). Report by Benjamin Wright and Canvass White (25 Jun 1825) contained in larger report.

combined with the rate of increase in demand, served to teach all involved not to take the existing surplus for granted.

In 1836, two years after the Watering Committee first expressed its opposition, Chairman Wetherill and Frederick Fraley, a prominent Philadelphian active with the Schuylkill Navigation Company, traveled to Harrisburg three times to present testimony before the state legislature. Graff went once and presented a drawing to illustrate how the planned Western Canal would have a negative effect on the water supply of the city. In the end, both this proposal and a similar one in 1838 were defeated.[99] The Annual Report for 1836 speaks of trade but implores fellow citizens not to support projects interfering with the city's supply of water.[100]

Another threat to Fairmount was as notable for its unexpected source as it was for its potential for harm. The manner in which the issue was resolved, moreover, would have lasting consequences.

From 1817 to 1825, recall, Joseph S. Lewis had served as chairman of the Watering Committee, taking careful advantage of every opportunity to improve the Fairmount Water Works and Philadelphia's water supply. In 1824, for example, he had negotiated the purchase all of the water power rights at Fairmount from the Schuylkill Navigation Company.[101] The agreement specifically gave the City of Philadelphia control of the locks and stretch of canal on the western end of Fairmount Dam, with all tolls being passed along to the canal company.

When the Schuylkill Navigation system was completed and revenue operations began in

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[99] H.S. Sprachman to Frederick Graff, 22 Jan 1835; Sprachman to Fraff, 24 Feb 1838, Autograph Collection of Simon Gratz; *Journal of House of Representatives,* 1837–1838 Session, I, 341, 495; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 94f, 302n.75.
[100] Watering Committee, *1836 Annual Report* (5 Jan 1837), 20.
[101] Watering Committee, *1824 Annual Report* (5 Jan 1825); published in *The American Daily Advertiser* (Philadelphia: 20 Jan 1825). The Annual Report also indicates that when the City of Philadelphia took possession of the canal and locks it found that the lower end of the canal needed to be dredged and that the wood lock gates were leaking and needed to be replaced.

1825, Cadwalader Evans, Jr. resigned as president of the Schuylkill Navigation Company and Lewis was elected to replace him.[102] Resigning from the chairmanship of the Watering Committee, Lewis immediately began working as vigorously for the canal company as he had for the City of Philadelphia. Once the boon of Fairmount, Lewis eventually became its bane.[103]

By 1832, the canal was so successful that the canal company, led by Lewis, embarked on a program of expansion. This meant either widening existing locks, or building additional parallel locks and stretches of canal in places where traffic was becoming increasingly congested. It also led to Lewis eventually pursuing the re-taking of one of the things which the Watering Committee, City Councils, and virtually all observers had believed the Schuylkill Navigation Company had sold to the City in 1824—physical possession of the locks and canal at Fairmount. Key events played out over exactly a year.

On 4 Feb 1832 Lewis wrote to William J. Duane, Chairman of the Watering Committee at the time, asking the Watering Committee to dredge the canal's lower outlet of built-up silt and install additional wickets[104] in the lock gates. Lewis also requested the work be completed prior to the canal opening for the warm-weather season at the beginning of March.[105] It's unclear from the wording of the letter whether Lewis was asking the Watering Committee to construct the wickets and perform the dredging or seeking permission for the canal company to do the work

[102] *Report of the President and Managers of the Schuylkill Navigation Company, to the Stockholders* (Philadelphia: Lydia R. Bailey, 2 Jan 1826), cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 90, 302n.52; and Edward J. Gibbons, "The Building of the Schuylkill Navigation System, 1815–1828," *Pennsylvania History,* Vol. 57, No. 1 (Jan 1990), 30.
[103] Lewis would serve as President of the Schuylkill Navigation Company from 1825 until his death in 1836.
[104] A canal lock is a system of large gates which allows a canal boat to pass from one level of a canal to another without the water at the higher level completely emptying into the lower level. A wicket is a small door within one of the larger doors of a gate. It is opened to allow the water level within the lock (between the two gates) to rise or fall so that a boat may pass through. Additional wickets would allow the water level to rise or fall more quickly and so allow boats to pass through the lock faster, thereby increasing the traffic capacity of the lock.
[105] Joseph S. Lewis to William J. Duane, 4 Feb 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 5.

itself. In any event, Duane replied that under the agreement of 1824 the City of Philadelphia was in no way obligated to make any improvements but merely to maintain what was already built. Duane invited the canal company to consider doing the work at its own expense.[106] In effect, Duane interpreted the letter as a request by the canal company for permission to do the work.

Lewis must have intended his letter as a request for the Watering Committee to carry out the requested projects because the canal company made no move all spring or summer to accomplish them. On 2 Oct he notified the Watering Committee that the lower lock still needed to be deepened by a least a foot. Not only that, because of increased traffic on the canal, the Schuylkill Navigation Company now needed to construct a second, larger canal and lock system next to the first one. It had already done this at eight other places; at Fairmount the lock-tender's house would need to be demolished and replaced with a larger one. Although Lewis did mention that this would all be done at the canal company's expense, this time he wasn't asking permission. He also acknowledged the obvious "clashing of jurisdiction in the management of the works at Fair Mount" and suggested that perhaps the agreement of 1824 should be mutually revisited.[107]

The Watering Committee, believing the City of Philadelphia to be in explicit possession of the locks and canal at Fairmount as part of its purchase of all water rights from the canal company eight years earlier, was startled at such a brazen attack on the rights of the City. The apparent assumption on the part of the canal company was that the City would simply acquiesce.

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[106] William J. Duane to Joseph S. Lewis, 16 Feb 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 6.

[107] Joseph S. Lewis to William J. Duane, 2 Oct 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 2. See also *The Water Works, The Misconduct of the Present City Councils in Relation to the Fairmount Water Works* (Philadelphia, Sep 1833), 4; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 90, 302n.54.

In mid-October 1832, newly-elected Select Councilman John Price Wetherill (17 Oct 1794–23 Jul 1853) became chairman of the Watering Committee, replacing Duane who left the Select Council after a single three-year term.[108] Wetherill had been elected to the Common Council in October of 1829 and had served as a member of the Watering Committee since then. He would serve as chairman until two years before his death. A man of science as well as business, Wetherill was involved in his family's paint and pharmaceuticals manufacturing firm. A member of the Franklin Institute, American Philosophical Society, and Geographical Society, and long-time vice-president of the Academy of Natural Sciences,[109] he would later serve as president of the Schuylkill Bank from 1846 to his death.[110]

Taking advantage of the delay in responding to Lewis caused by the transfer of responsibilities between Duane and Wetherill, the Watering Committee created a subcommittee to review the governing agreements between the City of Philadelphia and the Schuylkill Navigation Company. The subcommittee, whose members included Graff and City Solicitor John K. Kane, sought to clarify "the rights and privileges of the City in relation to the locks etc. opposite Fair Mount," consider the implications of Lewis' letter, and meet with the canal company's managing board when the opportunity arose.[111]

When Wetherill answered Lewis on 15 Nov he stated unequivocally that the Watering

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[108] William Duane, *Biographical Memoir of William J. Duane* (Philadelphia: Claxton, Remsen & Haffelfinger, 1868), 22, Library of Congress, call number 8681918, <https://archive.org/details/biographicalmemo00duan/page/n5>, accessed 14 Jun 2019. During a brief tenure as President Andrew Jackson's Secretary of the Treasury the next year, Duane would play a minor role in the controversy over the Second Bank of the United States.

[109] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 944ff; "John Price Wetherill Sr. (1794–1853)," *WikiTree*, <https://www.wikitree.com/wiki/Wetherill-29>, accessed 16 Jun 2019.

[110] John W. Jordan, Ed., *Colonial Families of Philadelphia*, Vol. II (New York, Chicago: The Lewis Publishing Company, 1911), 997.

[111] "Memorandum of the Office of the Watering Committee, 16 Oct 1832," *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 8.

Committee did not agree to allow the canal company to build a larger, parallel lock system. The reason was the increasing demand for water, and corresponding need for water power, for a growing city. Although he signaled that the Watering Committee was open to revisiting the terms of the 1824 pact, it would agree to no alterations without first consulting City Councils. In the last sentence of his letter, Wetherill specifically warned Lewis against acting unilaterally:

> …I beg leave to repeat, that until these modifications are mutually approved and adopted, neither party nor the other is at liberty to vary in any respect the existing state of things.[112]

Lewis replied on 27 Nov that the enlargement of the canal and locks at Fairmount were "indispensable" to the continued successful operation of the canal which was in the City's interest and he recommended that committees from each party meet the next day at the canal company's offices (not, it should be noted, at the Watering Committee's office nor at some location representing "neutral territory"). He also dropped this bombshell:

> The Board [of the Schuylkill Navigation Company] do not suppose that their right to use the water and water power of the river for the purposes of navigation to the extent they may deem necessary, is subject to any question, not that the alterations in the use of it at Fair Mount are such as makes it proper for them to communicate those alterations to the City Councils for their approbation [approval]. They are not aware that the management of the locks and canal at Fair Mount is to be classed among the rights of the City, but rather that it is a duty which, in relief of the Navigation Company, the City covenanted to perform.[113]

In other words, Lewis was interpreting the language of the sale of the water rights to

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[112] John Price Wetherill to Joseph S. Lewis, 15 Nov 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 9f.

[113] Joseph S. Lewis to John Price Wetherill, 27 Nov 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 10f. See also *The Water Works, The Misconduct of the Present City Councils in Relation to the Fairmount Water Works* (Philadelphia, Sep 1833), 5; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 91, 302n.55.

mean that the City of Philadelphia was merely managing the locks on behalf of the canal company and that in this subservient role it had no decision-making authority. He was arguing that the canal company still possessed control over the locks and canal at Fairmount, one of the things which the Watering Committee believed the City of Philadelphia had specifically paid the canal company $26,000 for in 1824.[114] Lewis was standing the conventional understanding of that agreement of sale entirely on its head.

Committees from each side did subsequently meet[115] but, perhaps not surprising, without resolving anything.[116]

At the Watering Committee's request, City Solicitor Kane reviewed the three controlling agreements between the City of Philadelphia and the Schuylkill Navigation Company—dated 3 Jun 1819, 20 Jul 1820, and 14 Jun 1824—and on 3 Dec 1832 provided a legal opinion as to the rights, privileges, and obligations of the City.[117]

Kane first summarized the agreements. Under the 1819 agreement, the City was obligated to build and maintain the Fairmount Dam, construct a canal, locks, and lock-tender's house, to the Schuylkill Canal Company's specifications. The canal company would use whatever water was necessary to operate the canal and locks and the City of Philadelphia could use all remaining water and water power existing at Fairmount. The 1820 agreement authorized the City of Philadelphia to raise the level of Fairmount Dam by eighteen inches. No other portions of the 1819 agreement were amended. Under the 1824 agreement, for the payment of $26,000[118] the

[114] The equivalent of approximately $793,900 in 2022.
[115] It is unknown whether the meeting took place the next day or at the canal company's offices as Lewis suggested.
[116] John Price Wetherill, "Report of The Watering Committee," 11 Dec 1832, a cover letter to *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 3.
[117] John K. Kane, Opinion of the City Solicitor, 3 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 11ff.
[118] The equivalent of approximately $793,900 in 2022.

City of Philadelphia owned all of the water power at the dam except that which was necessary to operate the canal and "shall have and take charge of the locks and canal at Fair Mount…" The City was obligated to maintain and repair the existing dam, canal, and locks.

Kane's opinion had five parts: 1. The City of Philadelphia owned the use of all of the water at Fairmount Dam except that which was needed to operate the canal; 2. The Schuylkill Navigation Company was only entitled to the water necessary to operate the canal and locks as constructed at the time of the 1824 agreement; 3. The City of Philadelphia was in lawful possession of the canal, locks, and locktender's house; 4. The Schuylkill Navigation Company had the legal right to use the canal, locks, and lock-tender's house to operate the canal; and 5. The Schuylkill Navigation Company had no right to alter the canal, locks, and lock-tender's house, unless the City of Philadelphia failed to properly maintain them.

Simply put, despite Lewis' astonishing interpretation, the City Solicitor reassured the Watering Committee that the legal position of the City of Philadelphia was that the Schuylkill Navigation Company was not entitled to the use of water at Fairmount for anything but the existing canal and locks, that the City alone possessed and controlled the existing property, including the canal, locks, lock-tender's house, and any other structure, and that the canal company did not have the right to alter any of it without the City's consent.

Ignoring the City Solicitor's views and Wetherill's earlier admonition, on 8 Dec 1832 Lewis forewarned John Gotwalt, the City-employed lock-tender, that when the canal closed for the season on 20 Dec the canal company would begin construction of the parallel canal and locks. Lewis told Gotwalt he had until 22 Dec to vacate the premises.[119] By this time Lewis must have given his workers the go-ahead to begin work because on the same day, fortified with

[119] Joseph S. Lewis to John Gotwalt, 8 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 14.

Kane's legal opinion, Wetherill notified Lewis that as "you are now actually proceeding in the contemplated work," the committee considered the canal company's actions a clear violation of the rights of the City of Philadelphia and gave "formal notice to desist." He also added, rather weakly, that the two parties could have seen what a court had to say about it all, but that Lewis didn't wait.[120] Two days later Frederick Graff, on behalf of the Watering Committee, reminded Gotwalt that he was not an employee of the canal company but had been hired by Graff as an agent of the City. Graff implored him to continue to perform his duties and not relinquish possession of the lock-tender's house.[121] On 11 Dec Wetherill notified Lewis that Gotwalt was under the authority of the City of Philadelphia, not the Schuylkill Canal Company, and that the lock-tender would not be complying with the company's directive.[122]

Perhaps sensing that Gotwalt was wavering, especially seeing that he had his family with him, Graff on 13 Dec sent word to the lock-tender, this time making a point of reminding him that he had to stay in his house with his family and that the only orders he was to obey were those of the Watering Committee.[123] The same day City Councils authorized the Watering Committee to do whatever it thought necessary to protect the canal, locks, and other property it controlled at the west end of Fairmount Dam and act in the interests of the City of Philadelphia.[124] The next day the chairman pro tem of the Select Council—the chamber which

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[120] John P. Wetherill to Joseph S. Lewis, 8 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 14f.
[121] Frederick Graff to John Gotwalt, 10 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 15.
[122] John P. Wetherill to Joseph S. Lewis, 11 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 15f.
[123] Frederick Graff to John Gotwalt, 13 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 16.
[124] Extract from minutes of Select Council, 13 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 2. The resolution was first introduced and passed in the Select Council and the Common Council passed a concurring resolution.

initiated the new resolution—reassured Gotwalt that the body was behind him, reminded him that his employment contract was made with Frederick Graff acting on behalf of the City, and enjoined him from delivering possession of the lock-tender's house to anyone but an agent of the City. He directed Gotwalt to immediately communicate with Graff should anyone instruct him to the contrary.[125]

Not to be outdone by an unfavorable opinion from a lawyer in the employ of the City, Lewis and the canal company hired three of the most prominent Philadelphia lawyers they could find to provide legal grounds of their own. To John Sergeant, Horace Binney, and Charles Chauncey,[126] Lewis posed three questions: Do we have the right to use all of the water at Fairmount which we need to operate the canal? Do we have the right to build an additional canal and lock system? Do we have the right to evict the lock-tender, raze the lock-tender's house, and replace the building with a larger one?[127] On 29 Dec the attorneys answered: yes, yes, and yes.[128]

In Sergeant, Binney, and Chauncey's submitted opinion, it is striking that they included in their review one document that is absent from the City Solicitor's review, something the three lawyers called "the source of all authority to the Company"—the original act of incorporation of

[125] Ephraim Haines to John Gotwalt, 14 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 16f.
[126] Sergeant (1779–1852) was a Federalist and Whig politician. An opponent of slavery, as a member of the U.S. House of Representatives he voted against the Missouri Compromise in 1820. In the 1820s he served as the president of the Pennsylvania Board of Canal Commissioners. A supporter of the Second Bank of the United States, he was Henry Clay's running mate in the 1832 presidential election but lost soundly to Andrew Jackson and Martin Van Buren just a month and a half before this opinion was written. Binney (1780–1875) was a Whig and Anti-Jacksonian politician, author, and public speaker. During the same election in which Sergeant lost, Binney was elected to the U.S. House of Representatives and served a single term. During the Civil War he published three pamphlets defending President Lincoln's suspension of the writ of habeas corpus. He founded the Hasty Pudding Club while attending Harvard University in 1795. Active on the Philadelphia legal scene, Chauncey (1777–1849) was a founding member and director of the city's Law Library Company.
[127] Joseph S. Lewis to Sergeant et al., 17 Dec 1832, included in published *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam* (Philadelphia: James Kay, Jun. & Co., Jan 1833), 3f.
[128] *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam,* 29 Dec 1832 (Philadelphia: James Kay, Jun. & Co., Jan 1833), 5ff.

the Schuylkill Navigation Company by the Pennsylvania state legislature on 8 Mar 1815.[129] They argued that because the state charter granted navigation legal priority over every other use of the Schuylkill River, the canal company had implicitly reserved to itself the right to do anything with the river it thought necessary for the purpose of navigation, even if it did not explicitly include such language in any agreement it may have made when selling water rights to another party. In fact, they declared, it was legally impossible for the canal company to sell or otherwise give away its right to do whatever it saw fit in order to maintain unimpeded and uninterrupted navigation upon the river.[130] By citing the original charter when the City Solicitor did not, the canal company lawyers' opinion effectively undercut the entire basis for the City's argument.

The lawyers didn't stop with the canal company's charter, however. They argued, quoting chapter and verse, that not only did the three agreements between the City of Philadelphia and the Schuylkill Navigation Company not weaken the canal company's rights, they actually reinforced them.[131] The three lawyers asserted that this absolute reserved right necessarily included the authority to add a canal and lock system, evict the lock-tender, and demolish the house in which he lived.[132]

On 29 Dec Wetherill accused Lewis of having "taken the law into your own hands" by starting construction on the canal expansion and communicating with the lock-tender before the controversy could be settled by the courts. Implying the willingness to use force if necessary, Wetherill warned Lewis that if he persisted, the Watering Committee "shall be compelled…to

[129] *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam* (Philadelphia: James Kay, Jun. & Co., Jan 1833), 5, 6ff.
[130] *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam* (Philadelphia: James Kay, Jun. & Co., Jan 1833), 8.
[131] *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam* (Philadelphia: James Kay, Jun. & Co., Jan 1833), 11ff.
[132] *Opinion of Counsel, on the Right of the Schuylkill Navigation Company to Make Another Lock and Canal for the Use of the Navigation at the Fair Mount Dam* (Philadelphia: James Kay, Jun. & Co., Jan 1833), 26f, 33f.

oppose your measures on the ground."[133] Lewis replied on 1 Jan 1833 that the Watering Committee may have lawyers telling it that it is in the right, but the canal company did as well. Moreover, Lewis promised, if the canal company was prevented from completing the additional lock and canal by "overwhelming force" or by legal means, and later legal decision should be found in favor of the canal company, it would sue the City for damages. If the canal company voluntarily ceased work, Lewis maintained, it would not be able to do that. Lewis then shrewdly invited the Watering Committee to engage in an arbitration conference to work out their differences, while the canal company would, of course, continue to work on the alterations in the meantime. That is to say, You don't mind if we keep working while we talk?[134]

Wetherill was out of town for the first week and a half or so of the new year and did not respond immediately. In the meantime, at 9:45 in the morning of 3 Jan 1833 John Gotwalt nervously notified Graff that canal company workers were excavating right next to the lock-tender's house, "close by the steps at the house I live in," and implored him to come see for himself.[135] Fifteen minutes later, with Wetherill absent, Graff urgently sought legal advice on how to proceed.[136] Gotwalt's understandable fears for his and his family's safety must have been assuaged because he continued to stand fast.

When Wetherill returned he responded to Lewis on 12 Jan by again advising him to cease construction and inviting him to cooperate with the Watering Committee in submitting the

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[133] John P. Wetherill to Joseph S. Lewis, 29 Dec 1832, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 17.

[134] Joseph S. Lewis to John P. Wetherill, 1 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 18f.

[135] John Gotwalt to Frederick Graff, 3 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 19.

[136] Frederick Graff to Lawrence Lewis, 1000, 3 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 19.

controversy to the legal system. Putting a fine point on it, Wetherill wrote,

> Permit me to urge anew the strong conviction which is felt by the Watering Committee, that while our controversies are, (as in a country of laws they necessarily must be), submitted to the tribunals of justice for determination, it would be manifestly irregular in the Company to proceed in a course of violence [forcible eviction of the lock-tender and continued construction], which assumes the power while the right is undecided.[137]

Lewis replied on 19 Jan that although he welcomed the idea of settling the matter in court, the lock-tender and his family needed to vacate the premises because canal company employees would continue work until a court decided the issue and the construction would eventually endanger the lock-tender's house and anyone still living in it.

On 21 Jan Graff reported to Wetherill that the lock-tender had found that someone had opened the gates of the guard lock, without authorization, and left them that way. Since the canal had been closed for the season for a month by then, Graff recommended the gates be chained and locked shut in order to prevent the locks from freezing open and exposing the canal to potential damage by any high-water event which might occur.

Wetherill insisted to Lewis on 22 Jan that the Schuylkill Canal Company must stop work before the two parties took the issue to court. The City of Philadelphia would not agree to surrender its rights before going to court.

Lewis continued to press forward. Taking advantage of a Pennsylvania law passed in 1826 which stated that any canal company employee who had been discharged yet continued to squat on canal company property could be evicted by the authority of a warrant from a justice of

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[137] John P. Wetherill to Joseph S. Lewis, 12 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 20.

the peace,[138] he and the board of managers of the Schuylkill Navigation Company served notice on 24 Jan 1833:

> …the Mayor, Aldermen and Citizens of Philadelphia,[139] be and they are hereby discharged from the present care and attendance of the locks at Fair Mount, and the collection of tolls thereat; and that the said Mayor, Aldermen and Citizens of Philadelphia, be and they are hereby required forthwith to deliver up the possession of the house, office and land occupied by them in the care, attendance and collection aforesaid, according to the provisions of the 10th section of the Act of the 10th April, 1826.[140]

The same day, Wetherill feebly objected:

> You have been already fully apprized of the views of the Watering Committee, and it seems to them a needless repetition now to say, that the proceedings contemplated by your Board are decidedly objected to, and can not be allowed.[141]

The Watering Committee was astounded at the behavior of the canal company but they weren't the only ones. Referring to the company's attempted public dismissal of the City of Philadelphia from the Fairmount locks and canal on 24 Jan, a local pamphleteer was indignant:

> It was a modest resolution and well worth reading twice over. The mayor, Aldermen and Citizens of Philadelphia are DISCHARGED from attendance of the locks at Fair Mount: how summary! how modest! The City have paid $26,000 to secure to themselves a right, and the

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138 The germane provision of the 10 Apr 1826 law is quoted in Wetherill's final *Report to the Select and Common Councils of the City of Philadelphia* (11 Feb 1833), appended to *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 44f.

139 The formal name of City until passage of the Act of Consolidation by the Pennsylvania state legislature in 1854. See "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854*, No. 16, §1 (Harrisburg: Boyd Hamilton, 1854), 21. For the sake of simplicity and clarity, the name "City of Philadelphia" has been used throughout this book.

140 Thomas Harper to John P. Wetherill, 24 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 25f.

141 John P. Wetherill to Thomas Harper, 24 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 26.

> Navigation Company DISCHARGE THEM from the trouble of enjoying it.[142]

"We wash our faces and boil our tea-kettles," the writer continued, "by the sufferance of the Schuylkill Navigation Company."[143]

Ignoring both Wetherill and public opprobrium, Lewis and the board of managers two days later formally notified Gotwalt that they were discharging him from his responsibilities as lock-tender and toll collector and demanded he relinquish possession of the lock-tender's house.[144]

Gotwalt stood his ground, as Graff and others had encouraged him to do, but Lewis was not bluffing in his threat to physically take control of the locks and canal. He and his legal team found a justice of the peace to provide a warrant for Gotwalt's eviction. On Monday morning, 4 Feb 1833, shortly after nine o'clock, Lewis showed up at the lock-keeper's house with Constable William Simpson and a dozen and a half employees from the canal company.[145]

When the constable served the warrant, Gotwalt instantly contacted Frederick Graff and admitted that it would be difficult indeed to physically resist the number of determined men arrayed against him.[146] Graff immediately replied and instructed Gotwalt to stand fast, attempting to steel his courage with specific orders:

> If any magistrate or constable calls on you and demands you to give up the house you now occupy, say to him that you will not unless instructed so to do by the Watering Committee of the Fair Mount Water Works, as it was by them you were placed there, and

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[142] *The Water Works,* 7; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93, 302n.64.
[143] *The Water Works,* 7; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93, 302n.64.
[144] Thomas Harper to John Gotwalt, 26 Jan 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 27.
[145] Deposition of Joseph Faulkner, 6 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 29ff.
[146] John Gotwalt to Frederick Graff, 4 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 28.

> without their express orders you have determined not to leave it. Be determined, and hold possession if you can until the Watering Committee can find out the magistrate who prosecutes, in order that they may have a hearing on the subject.[147]

Graff also enclosed a cease-and-desist letter with instructions for Gotwalt to show it to anyone attempting to evict him. It asserted that the City of Philadelphia had sole authority over the locks, canal, lock-tender's house, surrounding property, and the lock-keeper, while the canal company had no authority at all.[148]

When Gotwalt produced Graff's letter, Lewis read it, threw it down, and directed the constable to evict the man. Perhaps now thinking about his family's well-being as much as anything else, Gotwalt finally capitulated and asked for time to remove his possessions. Lewis refused, but Gotwalt defiantly collected his furniture and possessions anyway before departing. Joseph Faulkner, who had been hired six years earlier by the Watering Committee to assist John Gotwalt in administering the locks and canal at Fairmount, remained and attempted to hold possession of the lock-tender's house for the City.[149]

A little after four o'clock in the afternoon, Frederick Graff and a legal advisor came to the lock-tender's house and instructed Faulkner to retain possession of the building until Graff and the lawyer could appeal to the magistrate who issued the warrant. When Graff and his counsel left shortly after, Lewis immediately told Faulkner he could either leave on his own or he would be forcibly put out. Faulkner replied that he believed he was "doing his duty" toward the City of Philadelphia and he would not leave unless he was physically removed. Lewis finally

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[147] Frederick Graff to John Gotwalt, 4 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 28f.
[148] Frederick Graff to John Gotwalt, 4 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 29.
[149] Deposition of Joseph Faulkner, 6 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 29ff.

instructed the constable to remove Faulkner; the constable gently, but forcibly, shoved Faulkner out the door. Though by now only about a half dozen canal company employees remained, the Schuylkill Navigation Company gained complete physical possession of the lock-tender's house, locks, canal, and surrounding property.[150] The canal company wasted no time in demolishing the lock-tender's residence and finishing the new canal, locks, and lock-tender's house.[151]

Wetherill and the Watering Committee may have hinted at the use of force to keep control of the canal and locks, but their responses to Lewis were mostly in the form of legal hand-wringing and wan pleadings for cooperation. At times they talked tough, but even with the opinion of the public on their side, they ultimately shrank from following through until anything they may have done would have been too little, too late. Lewis and the Schuylkill Navigation Company's board of managers, on the other hand, were the driving force in the ongoing confrontation. Time and again the canal company acted and the Watering Committee reacted.

A question may occur to the modern observer: Why didn't the City of Philadelphia at some point simply dispatch police to hold possession of the locks and lock-tender's house? The reason is that none of the components of the Fairmount Water Works was located within the boundaries of the City of Philadelphia. The eastern end of Fairmount Dam, as well as the Mill House, Engine House, and Fairmount Reservoir, was located in the Spring Garden District. The western end of the dam, including all of the canal components there, was in the West Philadelphia District. Philadelphia police had no jurisdiction and the local municipality had no reason, nor desire, to involve itself in a dispute between two third parties.

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[150] Deposition of Joseph Faulkner, 6 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 29ff.
[151] John P. Wetherill's final *Report to the Select and Common Councils of the City of Philadelphia* (11 Feb 1833), appended to *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 41ff.

Wetherill impotently protested to City Councils,[152] but Lewis unapologetically defended the canal company's actions and dismissively discounted the dangers of diverting additional water from the Fairmount Water Works in order to operate an enlarged canal.[153]

Countering Lewis' assertions, Wetherill warned that the risk was all too genuine:[154]

> In the months of August, September, an October last two-thirds of the top surface of the dam was dry, and there was not water enough in the river to drive six wheels and pumps, without drawing down the water below the top line of the dam. … A diminution of water, therefore, occasioned by the increased demand of the Company for their locks, will render the City water works unfit for use. It will be recollected, that during the months referred to, the water in the river is always at its lowest ebb, and at the same time the demands of the city, even in healthy seasons, are the greatest. A return of the epidemic,[155] which during a part of the last season prevailed, and is believed to have been assuaged by a free distribution of water in the City and Districts, would be attended with consequences too mournful to be contemplated without alarm.[156]

Wetherill provided numerous measurements, records, and statistics to show that the expanded locks and canal would in fact divert a dangerous amount of water. He continued:

> Of the evils to arise to the City from the course pursued by your Company, there cannot

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[152] John P. Wetherill's final *Report to the Select and Common Councils of the City of Philadelphia* (11 Feb 1833), appended to *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 47.

[153] Joseph S. Lewis to John Price Wetherill, 14 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 32ff.

[154] John Price Wetherill to Joseph S. Lewis, 18 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 36ff.

[155] Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93. The "epidemic" refers to a spike in the cholera mortality rate in 1832. Philadelphia was not hit as hard as other cities; this was attributed at the time to the routine, regular washing of the streets with water from the abundant supply of the Fairmount Water Works.

[156]John Price Wetherill to Joseph S. Lewis, 18 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 39.

> exist the smallest doubt. When we calmly reflect, on both sides that they are, in the most favourable aspect you can present, the result of errors on the part of the company in their calculations of the extent of navigation which might at a future day exist, we cannot but feel, that the interests of the City have been sacrificed to the convenience of the Schuylkill Navigation Company.[157]

This was not mere rhetorical bluster on Wetherill's part. At the time there were five breast wheels and pumps in operation at Fairmount and the Watering Committee was in fact already pondering aloud whether or not there was sufficient water power left behind Fairmount Dam to drive the full complement of eight wheels when demand for water would make it necessary to install them:

> The low state of the river Schuylkill in August, September, and October last, when two-thirds of the dam was dry, induces the committee to believe that the whole water power of the river will not be sufficient to work eight wheels and pumps as was originally designed, and for which provision has been made in the buildings. They are supported in the opinion, from the circumstance that the water was frequently drawn down in the dam through the course of the day, during the above mentioned months.[158]

In a last desperate move, the Watering Committee directed Frederick Graff to spike the lock gates shut. Although this sounds like some sort of sabotage in which the gates would have perhaps been nailed shut in some way, it was in fact a routine operation. "Spiking a gate" is a simple bit of canal terminology. It is still commonly heard in Great Britain, for example, where

[157] John Price Wetherill to Joseph S. Lewis, 18 Feb 1833, *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 39.
[158] Watering Committee, *1832 Annual Report* (14 Feb 1833), published in *Hazard's Register of Pennsylvania,* Vol. XI (Jan–Jul 1833), 171 (printed as page 181 due to typographical error).

there are many hundreds of miles of historic canals still in use[159] by work and pleasure craft. Spiking is one way of opening or closing the wicket within the gate of a lock.[160] The spike (usually called a "handspike") is a detachable hardwood stick, often shaped rather like an axe handle, which is used to operate a ratcheted rack-and-pinion gear system which opens or closes the wicket.[161]

The Watering Committee's request suggests that the canal managers had intentionally left the lock's gates open in a high-stakes "game of chicken," so to speak, in order to threaten a water shortage and force the City's hand. Although this would have been the proverbial cutting off their nose to spite their face, the canal managers may have considered the long-term gain worth the short-term risk.

During a freezing rain in the middle of the night, Graff dutifully led a team of men who attempted to shut down the lock. It is not known if the effort was successful but Graff became soaked to the skin in the icy weather and caught a terrible cold, which at his moderately advanced age—58 at the time—caused him to be sick for nine months, spending much of the time bed-ridden. It appears his health never fully recovered.[162]

At the instruction of City Councils, the Watering Committee again prepared to sue the Schuylkill Navigation Company. It also petitioned for legislative relief from the Pennsylvania

[159] "Our Canal & River Network," *Canal & River Trust* (2021), <https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network>, accessed 13 Feb 2021.
[160] Recall that the wicket is a small door within the larger door of the gate which is opened and closed in order to allow water into and out of the lock chamber in order to lower a canal boat traveling downstream or raise a boat traveling upstream. In order to prevent the lock from being operated, the rack-and-pinion actuator would need to be chained and padlocked. The wicket is called a "paddle" on the British canal system today; it is almost always opened or closed using a detachable metal hand crank (called a "windlass") instead of a wood stick.
[161] "Calder and Hebble Handspikes," *Pennine Waterways: Calder and Hebble Navigation* (2020), <http://www.penninewaterways.co.uk/calder/handspike.htm>, accessed 13 Feb 2021.
[162] Henry Simpson, *The Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 434.

legislature. The state did nothing and the lawsuit dragged on for years.[163] The Watering Committee attempted to negotiate a settlement, but by 1842 it was evident the canal company wasn't going to budge. In January of that year, the Watering Committee reported that "so long as the Company be permitted to hold the property wrested from the City, and to make use of the weighing-lock (which last summer consumed 5,000,000 gallons of water per day, contrary to agreement), it will not feel any disposition for the reconciliation so much desired by the City."[164] The canal company was riding high and enjoying the prestige and political influence that came with the success and profitability of the canal. As long as it was in a position of strength it simply saw no reason to negotiate anything away. And there the matter rested. The City of Philadelphia never regained control of the western end of Fairmount Dam.

In the end, Wetherill's pronouncement at the end of his final report to City Councils on 11 Feb 1833 is perhaps the best summation of the entire sorry episode:

> The agreement of 14th June 1824, between the city and the Company, has become practically a dead letter; and the sum of twenty six thousand dollars,[165] paid by the City, in good faith, according to its terms, is worse than thrown away.[166]

The Schuylkill Navigation Company's assault on the rights of the City of Philadelphia at the west end of Fairmount Dam was complete and unequivocal. The Watering Committee was not only well and truly beaten but it had been defeated by someone who was formerly one of their own. It must have been galling.

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[163] Watering Committee, *1833 Annual Report* (23 Jan 1834), 6; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93, 302n.65.
[164] Watering Committee, *1841 Annual Report* (20 Jan 1842), 7; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 93, 302n.66.
[165] Over $663,400 in 2021 dollars.
[166] Watering Committee, *Report to the Select and Common Councils of the City of Philadelphia* (11 Feb 1833), published in , *Correspondence of the Watering Committee with the Schuylkill Navigation Company, in Relation to the Fair Mount Water Works* (Philadelphia: Lydia R. Bailey, 1833), 47.

Perhaps the greatest threat to the Fairmount Water Works, however, came not in the form of an acrimonious frontal attack but as an irresistible opportunity. What tasted sweet in the mouth, though, eventually turned sour in the stomach.[167]

When the water-powered system began operating at Fairmount in 1822, the City of Philadelphia enjoyed for the first time the capability of producing far more water than it needed. As the city and its water consumption grew, and the Fairmount Water Works expanded, this remained the case for many years. Early on, the Watering Committee and City Councils realized that some of the surplus could be sold for a profit to potential customers in the surrounding municipalities.

In the districts, the issue of whether or not to access the Philadelphia distribution system and "take Fairmount water" became one of none-too-small controversy. Residents and business owners were generally in favor of it, but the local commissioners were very protective of their political influence. Relying on Philadelphia for water would necessarily reduce their independence.

Nevertheless, on 26 Apr 1826 the Spring Garden district commissioners became the first to sign an agreement with the City of Philadelphia for water. Under the agreement all customers would be charged water rents fifty percent higher than for customers within Philadelphia. The commissioners would collect the rents and keep six percent. In return, they would pay for and lay their own distribution system and connect it to the Fairmount Reservoir.[168] By January of the following year, there were over 100 customers in the district.[169] The commissioners in Southwark agreed to an arrangement similar to the one for Spring Garden on 1 Jun 1826.

[167] See *The Holy Bible,* Revelation 10:8–10.
[168] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. I (Philadelphia: L. H. Everts & Co., 1884), 617.
[169] Watering Committee, *1826 Annual Report* (22 Jan 1827), passim.

In Northern Liberties, however, both commissioners and residents alike resisted Fairmount water. Even after over thirty structures were destroyed in May 1825 by the third serious fire there in three years, in the election that fall, candidates for office who ran in favor of connecting to Fairmount were defeated. Advocates mounted a successful campaign to persuade the public, though, and on 6 Jun 1826 the Northern Liberties commissioners signed an agreement like those for Spring Garden and Southwark.[170] In 1833, Kensington became the last of the major nearby municipalities to access the Philadelphia water supply.[171]

Three years earlier income from water rents had exceeded expenditures for the first time. Revenue was $60,037[172] and expenses were $35,661,[173] creating a profit of $24,376.[174] There were over 10,000 customers and the average daily consumption was over two million gallons.[175] By 1840, both the number of customers and the average daily consumption roughly doubled; revenue was $126,074,[176] expenses were $22,452[177], and the profit was $103,622.[178]

Within just a few years of the Spring Garden commissioners agreeing to connect to the Philadelphia water supply, however, the municipality's politicians and their constituents had begun to chafe at the fifty percent higher water rents the City of Philadelphia charged over the water rents it charged those within the city limits. The Watering Committee and City Councils believed the higher rents were justified because the City had assumed all of the risk and

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170 J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884*, Vol. I (Philadelphia: L. H. Everts & Co., 1884), 614, 617.
171 Watering Committee, *1833 Annual Report* (23 Jan 1834), 5.
172 The equivalent of approximately $1.93 million in 2022.
173 The equivalent of approximately $1.15 million in 2022.
174 The equivalent of approximately $784,700 in 2022.
175 Watering Committee, *1831 Annual Report* (12 Jan 1832), 3; and Watering Committee, *1851 Annual Report* (1852), 41. The annual report for 1851 lists revenue as $68,918.27. The reason for the discrepancy is unknown.
176 The equivalent of approximately $4.29 million in 2022.
177 The equivalent of approximately $764,300 in 2022.
178 Watering Committee, *1851 Annual Report* (1852), 42. The amount was the equivalent of approximately $3.53 million in 2022.

construction costs. As profits rose, however, the half-again higher rents became an increasingly bitter pill to swallow.

Unsuccessful at negotiating lower rents, the Spring Garden commissioners in 1842 appealed to the Pennsylvania state legislature for the authorization to build their own water works on the Schuylkill River upstream of Fairmount. Included in the request was a new contention. The commissioners claimed that the Fairmount Reservoir was not high enough to supply water to the higher elevations in the district. City Councils directed the Watering Committee to do whatever it thought necessary and appropriate to prevent the effort from succeeding.[179]

On 23 Jan 1843, Councils sent a detailed communication to the state legislature arguing that any diversion of water above the Fairmount Dam would violate the water power rights the City had purchased from various entities, especially the Schuylkill Navigation Company.[180] The cost to purchase the water rights and construct the Fairmount Water Works by this time exceeded two million dollars.[181] The City also objected to the issue of supply difficulties at higher elevations, pointing out that the Spring Garden commissioners had never mentioned this before.[182]

In order to bolster its legal argument, the City of Philadelphia hired W. M. Meredith and

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[179] *Journals of the Select and Common Councils of the City of Philadelphia, 1835–1854* (Philadelphia: 1836–1854). *Journal of the Select Council, 1842–1843,* 58, and *Journal of the Common Council,* 1842–1843, 66; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 95, 303n.76.
[180] Despite losing possession and control of the locks and canal at the western end of Fairmount Dam to the Schuylkill Navigation Company in 1833, the City of Philadelphia retained possession of the water rights at Fairmount which it purchased from the canal company in 1824.
[181] Watering Committee, *Reports of the Watering Committee, Made Jun 22, 1843* (Philadelphia: J. Crissey, 1843), 8; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 95, 303n.77.
[182] Watering Committee, *Reports of the Watering Committee, Made June 22, 1843* (Philadelphia: J. Crissey, 1843), 9; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 95, 303n.78.

Horace Binney[183] to write an amicus opinion. The two attorneys argued in their brief that by legal precedent, the Schuylkill River was considered *a priori* a thoroughfare and that all other uses were secondary. Any secondary uses were lawful only to the extent they did not have a negative effect upon navigation. This was the reason the City of Philadelphia found it necessary to purchase the water power rights from the Schuylkill Navigation Company in the first place. The navigation rights were controlled by the state legislature, the legislature granted the navigation rights to the canal company, and the City of Philadelphia purchased from the canal company the right to use the Schuylkill River water for anything other than navigation. The lawyers contended that once the City of Philadelphia held the water rights it purchased, those rights were inviolable by another party.[184]

To the extent the Pennsylvania legislature seriously considered the arguments of the City of Philadelphia, it ignored them. On 18 Apr 1843, the body passed a bill giving not only Spring Garden but any incorporated district the power to construct water works on the Schuylkill River without compensation to the City of Philadelphia if the City did not lower the water rents to the same as that for Philadelphia customers within three months.[185]

The members of the Watering Committee persuaded themselves that the City would win in court and advised Councils to stand firm. The committee did offer an olive branch—it would eliminate the fifty percent rent differential for customers within any district that agreed to a long-

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[183] This is indeed the same Horace Binney who helped provide legal grounds for the Schuylkill Navigation Company's seizure of the Fairmount locks and canal from the City of Philadelphia ten years earlier.

[184] *Opinions of Messrs. Meredith & Binney As to the Right of the Corporation of the City of Philadelphia to the Use of the Water Power of the River Schuylkill at Fair Mount Dam, March 1843* (Philadelphia: J. Crissey, 1843), 6f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.79, 303n80.

[185] *Laws of Pennsylvania, 1843 Session,* No. 147; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.79, 303n81.

term contract.[186] The Spring Garden commissioners, now believing they were negotiating from a position of strength, rebuffed the City's overture and forged ahead with plans to construct a steam-powered water works on the Schuylkill River to supply not only their own district but that of Northern Liberties as well.

On the instruction of City Councils, the Watering Committee told the districts that it still considered the City to have full possession of the water rights above Fairmount and would defend those rights. It also reiterated its offer to reduce the rents for long-term agreements, this time specifying twenty-year commitments.[187]

Councils went so far as to set up a joint committee on 9 Nov 1843 to negotiate with the districts.[188] By January, negotiations had produced an offer by the City to lower the rents for any district which signed a ten-year contract.[189]

Southwark and Moyamensing accepted the City's offer; each municipality agreed to a ten-year deal in exchange for equal water rents.[190] In order to induce Spring Garden and Northern Liberties to do the same, the City of Philadelphia offered to build an additional reservoir to supply the troublesome higher elevations. The districts would pay for the reservoir but the City would pay the five percent annual interest on the upfront loan necessary to fund its

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[186] Watering Committee, *Reports of the Watering Committee, Made June 22, 1843* (Philadelphia: J. Crissey, 1843), 4f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.82, 303n83.

[187] *Journal of the Select Council, 1842–1843,* 135f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.84.

[188] *Journal of the Common Council, 1842–1843,* 21f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.85.

[189] *Journal of the Common Council, 1842–1843,* Appendix, 28ff; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.86.

[190] *Journal of the Select Council, 1843–1844,* Appendix, 131; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.91. Also Watering Committee, *1844 Annual Report* (2 Jan 1845), 9.

construction.[191] Still blithely thinking they had the stronger position, Councils declared the offer would be good only until 7 Mar 1844.[192]

Possessing the authority from the Commonwealth of Pennsylvania to build their own water works since the previous July and perhaps sensing by this time that the Watering Committee and City Councils were merely stamping their feet in impotent protest, the commissioners of both municipalities ignored the ultimatum[193] and began construction on the works on 1 Jul 1844.[194] Located on the eastern side of the Schuylkill River just above Girard Avenue and powered entirely by steam, the system became operational on 31 Dec. Within a year, the district commissioners reported a profit.[195]

Still unwilling to concede, counsel for the City of Philadelphia requested an injunction from the Court of Nisi Prius[196] prohibiting the diversion of water above the Fairmount Dam. The court granted the injunction on 25 Aug 1845 but the districts immediately appealed the decision the Pennsylvania Supreme Court.[197] Hoping to leverage the Nisi Prius decision despite the

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[191] *Journal of the Common Council, 1842–1843,* Appendix, 28ff; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.86.

[192] *Journal of the Select Council, 1843–1844,* 58; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.87.

[193] *Journal of the Common Council, 1843–1844,* Appendix, 56;cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 96, 303n.88.

[194] Water Commissioners, *Report of the Water Commissioners to the Boards of Commissioners of the Districts of Northern Liberties & Spring Garden* (14 Dec 1843), 3ff, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.89.

[195] Joint Watering Committee, *Report of the Joint Watering Committee of Northern Liberties & Spring Garden Water Works* (Philadelphia: Barrett & Jones, 1846), 4f, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.90.

[196] The Court of Nisi Prius was a trial court in the City of Philadelphia presided over by one of the justices of the Pennsylvania Supreme Court. It was abolished by the Commonwealth of Pennsylvania Constitution of 1874. *Nisi prius* is Latin for "unless first or before." The name of the court could thus be taken to mean "court of original jurisdiction."

[197] *Journal of the Select Council, 1843–1844,* Appendix, 38, 110ff; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.92.

districts' appeal, Councils passed a resolution on 28 Aug which offered to seriously consider any reasonable suggestion for a mutually beneficial solution to the dispute. Both Spring Garden and Northern Liberties ignored the offer.[198]

It took nearly a year and a half for the state supreme court to render its decision but when it finally did so, on 8 Feb 1847, it ruled decisively against the City of Philadelphia. Writing for the court in a watershed decision[199] which had repercussions far beyond Philadelphia, Chief Justice John B. Gibson decreed that according to natural law the domestic uses of water from a river held priority over all other uses, including navigation, contrary to the implications of previous state legislation. The chief justice declared that while an entity can hold water rights, those rights are not exclusive and another entity may encroach upon those rights if the encroachment does no harm. Since the Spring Garden Works was only drawing 1.25 million gallons per day from the Fairmount Pool, and 75 to 250 times that amount was at the time allowed to spill over the Fairmount Dam every day (depending on the time of year), Chief Justice Gibson decided that no harm was done to the City and no harm would be done as far into the future as his eye could see.[200] Thus, the water rights the City had thought it had purchased were rendered virtually worthless twice over.

If the decision didn't precisely sweep aside and invalidate all of the water rights the City had ever purchased, it certainly came close. In its struggle to defend the exclusivity of its water rights on the Schuylkill River, the City of Philadelphia was soundly defeated. This did not go unnoticed. By 1853, the municipality of West Philadelphia was constructing its own water works

[198] *Journal of the Select Council, 1843–1844,* 105; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 97, 303n.93.
[199] Pun intended.
[200] "Mayor, &c. *v.* Commissioners of Spring Garden," 3–8 Feb 1847, *Pennsylvania State Reports,* VII, (Philadelphia: T. & J. W. Johnson & Co., 1870), 348ff.

as well. Located on the west bank of the Schuylkill River where the Philadelphia Zoo is today, and known after 1854 as the 24th Ward Works, the steam-powered system became operational in 1855.

The diversion of water was not insignificant. The Fairmount Water Works not only supplied the City of Philadelphia and the surrounding municipalities with water it drew from behind the Fairmount Dam, it also turned some of that water's potential energy into kinetic energy in order to power itself. Any reduction in the availability of water in the Fairmount pool incurred a double penalty for Fairmount.

In 1824, Fairmount's customers consumed 1.6 million gallons of water per day.[201] By 1852 average consumption was 5.7 million gallons per day, with a high of 7.3 million per day during July.[202] In 1851 Graff's son Frederic Graff, Jr., then Chief Engineer, had reported that the built-out Mill House could barely keep up with the demand.[203] When the residents of the district of West Philadelphia requested Fairmount Water the same year, Graff, Jr., advised against it.[204] The era of Fairmount producing a great excess of water was ending.

Making matters worse, nature's supply was not always consistent. This was amply demonstrated early on. From June through September of 1838, for example, a drought caused such a reduction in the flow of the Schuylkill River that water ceased to pass over the overflow portion of Fairmount Dam. In fact, when the Upper Ferry Bridge just below Fairmount—the landmark covered wood bridge also known as The Colossus—was destroyed by fire on 1 Sep of that year, the top planking of the dam was so dry that people used it as a temporary footbridge to

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[201] Watering Committee, *1836 Annual Report* (5 Jan 1837), 19.
[202] Watering Committee, *1852 Annual Report* (3 Jan 1837), 8.
[203] Watering Committee, *1850 Annual Report* (2 Jan 1851), 3ff.
[204] *Journal of the Select Council, 1851–1852,* Appendix, 4f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 99, 303n.102.

travel to and from each side of the river until the river once again began flowing over the dam nine days later. The wheels and pumps were worked over twenty hours per day, the maximum that could be done while the tide was out, in order to lift enough water into Fairmount Reservoir.[205] That year Philadelphians consumed an average of 3.8 million gallons of water per day, but during the drought, the figure rose to an average of 5.1 million gallons per day.[206]As the Watering Committee noted:

> Had the water in the pool fallen a few inches lower, it would have become necessary to alter the gates, so as to admit of working the water-wheels undershot. This circumstance is mentioned, in order to show the necessity of preventing if possible any interference with the water in the pool at Fairmount, for objects not embraced in the special contracts made with the Schuylkill Navigation Company.[207]

Despite the best efforts of the Watering Committee and City Councils, by 1847—indeed, by 1844 depending on how it is reckoned—that ship had decidedly sailed.

Within the next decade, however, the controversy between the municipalities would be rendered mostly moot for the City of Philadelphia, if not for Fairmount. In 1854 all of the municipalities within Philadelphia County, including the contentious districts of Spring Garden and Northern Liberties, would be rolled up into a greatly expanded City of Philadelphia. All of the rival water works and all of the neighboring distribution systems would be absorbed into Philadelphia's system. Overnight, all of the residents of the nearby districts would become residents of the City of Philadelphia and the agreements with those districts would become

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[205] Watering Committee, *1838 Annual Report*, published in *Journal of the Common Council of the City of Philadelphia, for 1838–1839*, Appendix 18 (Philadelphia: 3 Oct 1839), 19f.
[206] Watering Committee, *1838 Annual Report*, published in *Journal of the Common Council of the City of Philadelphia, for 1838–1839*, Appendix 18 (Philadelphia: 3 Oct 1839), 20.
[207] Watering Committee, *1838 Annual Report*, published in *Journal of the Common Council of the City of Philadelphia, for 1838–1839*, Appendix 18 (Philadelphia: 3 Oct 1839), 20.

obsolete.

The deleterious effects of the drawing of water from above Fairmount would linger, however. What were once independent pumping stations above Fairmount would continue to operate and the expanded City would construct additional ones. Collectively, the pumping stations above Fairmount would negatively affect the performance of the Fairmount Water Works, especially during dry periods. The consequences wouldn’t be immediately significant but would build over time. Eventually they would be a contributing factor in Fairmount’s demise. But that was still far in the future.

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Nature at times provided too little water; at other times it provided too much. Less than five months after the drought of 1838, on 26 Jan 1839 flood waters containing ice floes up to 18 inches thick rose to 10 feet 2 inches above Fairmount Dam. Over 300 feet of planking on the dam’s face was broken up and over 20,000 yards of rubble stone was swept away from the back of the dam, but the structure held. The machinery in the Mill House was completely inundated, the doors were burst open, and the woodwork on the walls and floors was damaged. The canal and locks on the west end of Fairmount Dam were submerged and canal boats were carried away.

There was considerable destruction downstream as well. The water's high mark at the Market Street Bridge exceeded by 18 inches the previous high mark set during a flood in 1784. The pontoon bridge at Gray's Ferry was swept away. As the floodwaters scoured the river bed, two stone piers of the Philadelphia, Wilmington, and Baltimore Railroad’s one-month-old

Newkirk Viaduct (located approximately where the Grays Ferry Avenue bridge is today) were undermined and toppled, bringing down part of the wooden superstructure. After the flood, the bottom of the river at the location of one of the destroyed piers was 16 feet deeper than it was prior.

Despite the havoc, the wheels and pumps in the Mill House survived intact, a testament to Graff's robust design. Fairmount was back in operation within 24 hours of the waters' receding, at which time Fairmount Reservoir still contained sufficient water to supply the City for four days.[208]

Fairmount Dam had been damaged, however, and after hasty repairs the Watering Committee hired two engineers, Michael Towers and F. Erdmann, to examine the dam and decide whether anything further needed to be done. On 3 Nov 1841 the pair recommended that the dam be renewed from the low water mark up, replacing the original hemlock timbers with white pine.[209] The work was begun in spring of 1842[210] and completed on 6 Dec 1843, with Towers superintending.[211] Two separate sections of 150 feet each were worked one at a time behind cofferdams.[212] At completion the actual cost came in approximately seven percent lower than the estimate.[213]

With flood events naturally occurring from time to time, it would seem that the fundamental safety of Fairmount Dam was apparent, but this had not always been the case.

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[208] Watering Committee, *1839 Annual Report* (16 Jan 1840), published in *Journal of the Common Council of the City of Philadelphia, for 1839–1840*, Appendix 30 (Philadelphia: 8 Oct 1840), 118f.
[209] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: Manly, Orr, and Lippincott, 1842), 45ff.
[210] Watering Committee, *1842 Annual Report* (Jan 1843).
[211] Watering Committee, *1843 Annual Report* (4 Jan 1844), 5; Michael Towers, *Report of the Superintendent for Rebuilding the Fairmount Dam* (16 Dec 1843), appended to 1843 Annual Report.
[212] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: Manly, Orr, and Lippincott, 1842), 46f.
[213] Watering Committee, *1843 Annual Report* (4 Jan 1844), 5.

Recall that in 1820, while the dam was still under construction, Watering Committee member William Rush, as chairman of the building subcommittee, was so dissatisfied with some of contractor Ariel Cooley's work that he and the Committee forced Cooley to remove a portion of the dam and rebuild it in a more substantial manner. Although the dam was tested by a flood in early 1822, before the water-powered system was even finished,[214] it seems Rush was never entirely happy with some aspects of its construction.

Strong in his opinions, Rush pushed hard in 1823 to reinforce the dam with large amounts of crushed rock placed along its face. Joseph S. Lewis, chairman of the Watering Committee at the time, rejected both the necessity and expense of the idea.[215] Although Rush left the Watering Committee in 1826—it's unclear whether he left on his own or was forced out—he continued to agitate for fortifying the structure. In 1828 the Watering Committee engaged a team of engineers to study the dam. They concluded that nothing needed to be done to it but the Watering Committee established a schedule of annual inspections to be sure.[216] Rush argued in the local newspapers that it was foolish to rely on continuing examination when shoring up the structure would be once-and-done.[217]

Each high-water event, however, made the idea of reinforcing the dam the way Rush desired appear less and less imperative. The great winter flood of 1839 made it a dim memory. Fairmount Dam would be repaired, renewed, and altered over the years, but not until the mid-

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[214] Watering Committee, *1822 Annual Report* (9 Jan 1823), 14.
[215] Joseph S. Lewis, *Observations Upon Stoning in Front of the Dam, Read Before Watering Committee* (6 Aug 1823), Etting Collection, Historical Society of Pennsylvania; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 89, 302n49.
[216] Watering Committee, *Report of the Watering Committee … Relative to the Dam at Fair Mount* (Philadelphia: Lydia R. Bailey, 23 Sep 1828); cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 89, 302n50.
[217] Philadelphia Gazette (25 Sep 1828); cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 89, 302n51.

1920s would it see an improvement close to that which William Rush had envisioned.

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Since 1815, Frederick Graff had labored for the City of Philadelphia for the same compensation, just $2,000 per year. Except for a single bonus in 1813, he had received only two silver vases in the way of formal recognition of his dedication and hard work.[218] Silver vases, however, didn't pay the bills. He received no reimbursement for professional travel expenses, including the need to maintain a horse which cost 7½ percent of his salary, or other expenses, including such things as the cost of materials to make numerous engineering models used to defend against spurious claims against the City. In 1833 he appealed to City Councils for a raise. In the request, called a "memorial," Graff argued that although he served as Superintendent of the Fairmount Water Works and was paid for his services as superintendent, he also served as sole design engineer, sole draftsman, and sole accountant for the entire water distribution system but his salary did not reflect the reality of these additional responsibilities. He recounted the many times he had worked long hours for things not directly connected with his official duties, either because he was asked to or simply because he decided on his own initiative that something needed to be done.[219]

The typical annual salary for a civil engineer of Graff's rank at this time hovered around

[218] One in 1816 and another in 1828.
[219] Frederick Graff to the Select and Common Councils of the City of Philadelphia, "The Memorial of Frederick Graff" (17 Apr 1833).

$3,000,[220] half again more than he was receiving.[221] Add in the unpaid responsibilities and expenses and it is clear Graff was severely undercompensated. Graff never did receive any additional remuneration, however. In a great example of "taking for granted," City Councils turned a deaf ear. Graff was never given another bonus and his salary was never increased, remaining at just $2,000 per year[222] until his death fourteen years later.[223]

Despite all of this, Graff's son, Frederic Graff, Jr. (21 Mar 1817–30 Mar 1890), joined him at the water works as Assistant Engineer on 6 Apr 1842[224] at the age of 25. Graff hadn't at first wanted his son to follow him in the field of engineering. After the boy had completed his education, Graff had arranged for him to work in a large hardware business. The younger Graff's technical inclination and inventive talent, however, suited him far more for engineering than for commercial pursuits and he found himself drawn to his father's work.[225] The Watering Committee initially paid him an annual salary of $300,[226] less than half of what he could have been earning elsewhere.[227] Young Frederic must have learned from his father a passion for civil commitment in general and for the Fairmount Water Works in particular.

On 13 Mar 1836 Joseph S. Lewis died at the age of 57. He had served as chairman of the Watering Committee from 1817 to 1825 and was instrumental in the creation of a water-powered system at Fairmount. As president of the Schuylkill Navigation Company from 1825 until his

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220 The equivalent of approximately $106,000 in 2022.
221 Mark Aldrich, "Earnings of American Civil Engineers 1820–1859," *The Journal of Economic History*, Vol. 31, No. 2 (Jun 1971), table at 409. For the period 1831 to 1845, Aldrich reports a low of $2,650 and a high of $3,272 for average reported annual salaries for an "Engineer of the First Rank," which certainly describes Frederick Graff. After 1845 the average stayed significantly above $3,000.
222 The equivalent of approximately $70,500 in 2022.
223 Watering Committee, *Annual Reports* from 1833 to 1847.
224 "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519.
225 "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 517ff.
226 Compare Watering Committee, *1841 Annual Report* (20 Jan 1842), 17, and Watering Committee, *1843 Annual Report* (4 Jan 1844), 22.
227 Mark Aldrich, "Earnings of American Civil Engineers 1820–1859," *The Journal of Economic History*, Vol. 31, No. 2 (Jun 1971), table at 409. For the period 1830 to 1840, Aldrich reports a low of $632 and a high of $780 for reported average annual salaries for an "Engineer of the Third Rank."

death, however, his aggressive and antagonistic relationship with his former colleagues left such a bitter taste in enough mouths that apparently many who were associated with the Water Works were reluctant to give him his full due. He must have begun rubbing City officials the wrong way shortly after his departure from the Watering Committee. Even prior to his spearheading the clawback of the locks and canal at the west end of the Fairmount Dam from City of Philadelphia, William Rush in 1830 wrote a lengthy newspaper article in which he urged the reader against giving to Lewis all of the credit for Fairmount.[228]

Lewis may not deserve all of the credit, of course, but he does deserve a large portion of it. It seems he was the first to recognize the potential for using water power at Fairmount instead of steam to power the supply of water. The idea of replacing the steam operations at Fairmount with a water-powered system seems to have been originally conceived by Lewis. He actively and extensively investigated the possibility and when he was convinced of its practicality he pushed hard for its development. Water power at Fairmount was accomplished under his leadership.[229] He was a controversial figure to be sure but absent his vision and tenacity, the water-powered Fairmount Water Works may never have existed at all.

Today Frederick Graff usually receives the lion's share of the credit for the inception of the Fairmount Water Works, and that is as it should be, but it is also true that his efforts and those of Lewis went hand in hand. Lewis was the visionary leader who convinced the City of Philadelphia that it *should* be done. Graff was the brilliant engineer who figured out how it *could* be done. Lewis pointed the way. Graff made it a fully functioning reality. Many others were involved in creating the Fairmount Water Works, of course, but both Lewis and Graff had

[228] *Philadelphia Gazette*, 8 Jan 1830; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 90.
[229] Thomas Gilpin, "Fairmount Dam and Water Works, Philadelphia" (3 Apr 1852), published in *The Pennsylvania Magazine of History and Biography,* Vol. 37 (Philadelphia: 1913), 477f.

outsized roles in its creation and success.

Shortly after the Fairmount Water Works first opened to the public in the summer of 1822, a local newspaper published a letter from an anonymous reader:

> On the first of the present month, the councils and officers of the city, with several of the citizens, attended the first public exhibition of the new Waterworks at Fair Mount. The spectacle was so full of satisfaction to all present, and a theme of such high praise to the gentlemen who have had the management of the great work, of which it demonstrated the perfection, that I hope you will permit a spectator to use your Gazette, for the purpose of imparting some of this satisfaction to the public at large. The works recently erected at Fair Mount are a proud monument to the city of Philadelphia; but as a specimen of consummate art, and an instance in which the genius and industry of man have controlled to the purpose of domestic comfort, the entire waters of a deep and powerful river, they are an honour, and *will doubtless be a subject of interest to the whole of this country.*[230]

The writer of the letter likely did not realize just how prescient he or she was.

[230] *National Gazette*, (Philadelphia, Pennsylvania: 5 Jul 1822). Emphasis is the author-editor's.

CHAPTER 5

CELEBRATED SYMBOL OF THE YOUNG REPUBLIC

To say that the Fairmount Water Works struck a chord with Americans would be a fantastic understatement. Within just a few years of its conversion to water power, it came to be celebrated like no other single location in America at the time. In terms of public awareness it ranked second only, perhaps, to Niagara Falls. Two concurrent streams of American thought and culture combined to catapult Fairmount to an unprecedented lofty level of recognition and national symbolism.

The first stream was the philosophy of republicanism.[1] Still a significant influence on the American body politic today, the concept has roots in eighteenth-century Britain and was a driving force in the American Revolution. It had—and continues today to have—two major components.

The first component of republicanism was the basic form of American government, not a pure democracy but a representative republic in which the Constitution protects the pre-existing rights and liberty of the people not just as a whole but as individuals as well.[2] This role of the Constitution—the protection of the individual against the encroachment of government and the minority against mob rule—was and is seen as foundational to the unleashing of the human

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[1] The concept referred to here is small-R republicanism, independent of party politics; indeed, the Republican Party would not be formed until 1854. See James F. Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776–1900* (New York: Penguin Books, 1976); Ruth Swartz Cowan, *A Social History of American Technology* (New York: Oxford University Press, 1997); Michael Stokes Paulsen et al., *The Constitution of the United Text, Structure, History, and Precedent (University Casebook),* (New York: Thomson Reuters/Foundation Press, 2010); and Randy E. Barnett, *Our Republican Constitution: Securing the Liberty and Sovereignty of We the People* (New York: HarperCollins, 2016).

[2] Michael Stokes Paulsen et al., *The Constitution of the United Text, Structure, History, and Precedent (University Casebook),* (New York: Thomson Reuters/Foundation Press, 2010), 41f, 45f, 680ff, 1650ff; Randy E. Barnett, *Our Republican Constitution: Securing the Liberty and Sovereignty of We the People* (New York: HarperCollins, 2016), 52ff, 62ff.

creative spirit, allowing individuals to reach their full potential as never before. In 1822 the United States was still less than fifty years old, young by any measure. Americans were eager not only to prove themselves but also to demonstrate the superiority of their form of government.

The second component of republicanism was public and private virtue. It stressed industriousness, personal restraint, service to one's community and country, and mutual responsibility for public servants and private citizens alike. Selflessness and moral rectitude was considered necessary for a strong civil society. Perceived as equally important was raising responsible and virtuous children, being a productive employee, building a profitable business, or working for the improvement of the lives of those within one's sphere of influence, for example. These were seen not only as admirable aims in themselves but also as crucial to keeping the country strong.

Americans in the late eighteenth and early nineteenth centuries generally believed they were creating a new and better civilization, one in which individuals were free to pursue what was important to them. Americans saw their role as the vanguard in a new era. They had already created a remarkable middle-class society. Although the country was mostly rural, with a strongly agrarian economy, by the third decade of the nineteenth century technology[3] came to be viewed as a tool for achieving a grand era of progress. Americans believed technological development would expand liberty and energize the country. The resulting prosperity, they believed, would prove to the world the superiority of republicanism. The historian John F. Kasson has remarked that, far from fearing technology, Americans at the time…

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[3] Although physician Jacob Bigelow, in 1829, was the first to use the word *technology* in a similar fashion to the way we use it today (in his *Elements of Technology, Taken Chiefly from a Course of Lectures…on the Application of the Sciences to the Useful Arts*), until the mid-nineteenth century it generally meant the study or description of an art form, especially of the practical arts. It was not until the early twentieth century that the word as we know and use it today gained wide currency. See Leo Marx, *The Machine In the Garden: Technology and the Pastoral Ideal In America* (New York: Oxford University Press, 1968), 149, 376n5; and David Freeman Hawke, *Nuts and Bolts of the Past: A History of American Technology, 1776–1860* (New York: Harper & Row, 1988), 7f.

> …glorified machines not simply as functional objects but as signs and symbols of the future of America. They beheld plumes of steam and whirling wheels with a double vision, like a father over his infant son, inflating each movement with dreams of what it might presage.[4]

The second stream responsible for the emerging renown of the Fairmount Water Works was the American idealization of the harmony of technology and nature. The tension between the pastoral ideal and the necessities of civilization is an ancient theme, not distinctly American. The American experience of comparatively quickly developing a previously wild undiscovered country was unique, however, especially compared with European history. Early on, the American continent was described as either a land of overwhelming natural abundance or an unforgiving, howling wilderness, depending upon who was doing the describing. Within a few generations a "middle landscape"[5] between the perceived extremes was established. This relatively rapid development brought the pastoral-technological tension into high relief as nowhere else. With the garden as metaphor for America itself, technology—the machine—threatened to be a permanent disruption.

By the 1820s, however, Americans had embraced technological development. This was partly a natural result of republicanism, but it was also due to Americans' ambivalence about nature itself. Nature was largely seen as valuable to the extent that it could be made to be functional. Far from being thought of as diminished or spoiled by technology, nature was considered enhanced by it. Not only was the "machine in the garden" not popularly perceived as a negative thing, most people at the time thought the machine actually improved the garden.

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[4] John F. Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776–1900* (1976), 41.
[5] Leo Marx, *The Machine In the Garden: Technology and the Pastoral Ideal In America* (New York: Oxford University Press, 1968), passim, esp. 71, 113, 121, 138f, etc.

Nature, in other words, was never more beautiful than when it was made useful.[6]

Americans began to prize things which suggested that nature and technology could be harmonized and the Fairmount Water Works fit the bill like nothing else. It represented the integration of the pastoral and the technological, of nature and civilization. More than that, Fairmount represented nature improved. It was the embodiment of the power of the human intellect over the primal forces of nature. It was nature made supremely beneficial, *dolce et utile.* In the Fairmount Water Works, the machine and the garden became one.

Nine years after the inauguration of the water-powered system a Philadelphian could unabashedly write:

> Among the many subjects of felicitation which our citizens possess in an eminent degree, none should be more highly esteemed than the Water Works. … [I]t is a fact that the beautiful scenery of the Schuylkill, has been much enriched by the establishment of the works in their present form—few places, we believe, in the vicinity of any city in the Union can vie with Fair Mount by moonlight, in the richness of the neighbouring cultivated lands, the adjacent hills dotted with variously disposed habitations, the city in the rear, with its low hum of retiring business, and the beautiful stream below, the gush of the waterfalls, and the ripples tinged with the silvery beams of the moon, give Fair Mount a high claim to the attention of those who can appreciate such scenery, and find pleasure in the tranquil softness of an evening hour.[7]

American author and poet Caroline Howard Gilman (1794–1888) declared in 1838:

> I am most grateful for beauty in all its forms. Had I been carried blindfold to the machinery at Fair Mount, and then permitted to behold it alone, I should have been agreeably

[6] Leo Marx, *The Machine In the Garden: Technology and the Pastoral Ideal In America* (New York: Oxford University Press, 1968).
[7] Thomas Porter, *Picture of Philadelphia, from 1811 to 1831*, Vol. II (Philadelphia: Robert Desilver, 1831).

excited by its singular combination of simplicity and power; its wheels would have rolled on awhile in my memory, I should have paid the usual tribute of wonder to man's ingenuity, and have dreamt of those iron arms that seem so human in their operations; but now that I have gazed on the placid river, marked the shaded green of its beautiful borders, seen the sculptured images awaking graceful associations, stood by the clear basin and felt a longing like youth to rush in and stand under its showery fountain, heard the roar of the giant Art [technology] contending with and counteracting the giant Nature, climbed the precipitous eminence, and watched the setting sun throwing his golden smile on all, this leaves a deeper stamp—the stamp of the beautiful; and as I feel now the cool elements on my hands, or taste its freshness, I am carried back to that scene on the Schuylkill.[8]

In the 1843 a correspondent for a Brooklyn newspaper echoed the sentiment:

> Fairmount…is a perfect whole; its beauty and magnificence can be seen and estimated almost at a glance; it looms up before the eye, a mountain of sublimity and wonder. As you enter its shaded retreats, playing fountains of the crystal liquid meet you at every step—green and luxuriant grass plats skirt its gravelled walks; upon your right frowns, or rather smiles, in native grandeur, a high projecting bluff; its brow is decked with tree and shrub, to which they seem to cling with a frail tenure. You enter the machinery department, and view the wonderful devices of man to turn the current of a mighty river from its native bed, over high and rugged mountains; indeed, it seems that here a fierce strife between nature and art [technology]—between man and his God—has been waged for the supremacy, and the spectator would be at a loss to determine where the palm belonged, to nature, or art; and to my mind can be best awarded by applying it to both, as most happy adjuncts in the accomplishment of a wonderful enterprise.[9]

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[8] Caroline Gilman, *The poetry of traveling in the United States* (New York: S. Colman, 1838).
[9] "Correspondence of the Star, Philadelphia, July 23, 1843," *Brooklyn Evening Star* (Brooklyn, New York: Wednesday, 26 Jul 1843), 2.

In the 1844 a correspondent for a local Philadelphia newspaper, was saying something similar:

> As I continued my walk around the works, I could not but recall the primitive appearance of this spot, when the bluff of rock, now made so useful, extended its rugged foot to the very edge of the river, seeming to frown upon all attempts at improvement, and to defy the efforts of man to remove it. I have watched the progress of these works from that time to the present, and was, therefore, much pleased, when apprised of the fact (of which, perhaps, few of our readers are aware) that the original design is now completed.
>
> The mill-house is now entirely occupied by eight effective water wheels and pumps—the hill above covered to its entire extent with reservoirs, which will guaranty to the city a sufficient supply of water for many years to come, and the grass-sodded banks, gardens, &c. are fully completed, thereby adding to the beauty and utility of the works.[10]

An anonymous source later pronounced:

> The glory of Philadelphia is its water works. These unite in themselves, and the adjacent country and river prospect, beauty of scenery, usefulness of purpose, magnitude of design, excellence of effect, nature and art, all harmoniously blended. What delightful scene, more worthy of the painter's art and the poet's pen! There we see the graceful, glittering river winding amongst its wooded banks, the artificial cascade at your feet, the lovely jet d'eaux all around, the green plats and gravelled walks through which you have walked, the picturesque views wherever you cast your eyes, these go to make up the picture which is spread out in rich luxuriance before you. All this change of Fairmount, by the hand of art, is a fair exchange for the loss of its original rugged, woody and romantic cliffs, then all solitary and silent, now all busy with active life, and useful, by its public utility, sustaining the health and

[10] *Public Ledger* (Philadelphia, Pennsylvania: Tuesday, 25 Jun 1844), 1.

blessing the city inhabitants.[11]

Because of their cultural preconception, Philadelphians—and Americans in general—were primed to welcome and celebrate the Fairmount Water Works. Indeed, it was highly anticipated even before it was completed. In the summer of 1822 a newspaper was already reporting…

> …the New Water Works at Fair Mount, on the Schuylkill, for supplying the city of Philadelphia, with water, are nearly completed. The works are moved by water power. They will consist of eight wheels and pumps. One wheel and pump is now in complete operation. [Two additional] pumps will be put in operation this season…
>
> The head race and sites for the works were excavated from a solid rock. Some idea may be formed of this herculean task, from the statement that the mere gunpowder used for blasting, though procured at very low prices, cost upwards of $12,000![12]

The day after Christmas, 1822, two days after the last of the three initial wheel-and-pump sets began operating, a local citizen wrote to one of the newspapers in town:

> Yesterday, the Select and Common Councils, the Mayor and Citizens, repaired to Fair Mount, to witness the gratifying spectacle of the successful and complete operation of these great and stupendous works, destined to furnish the city and suburbs with an ample supply of wholesome water for all purposes.
>
> The three wheels were set agoing, discharging into the basins, three millions nine hundred thousand gallons of water every twenty-four hours, which is all the present reservoirs can contain, and nearly three times the quantity necessary for present demand.

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[11] John F. Watson, *Annals of Philadelphia in the olden time; being a collection of memoirs, anecdotes, and incidents of the city and its inhabitants, and of the earliest settlements of the inland part of Pennsylvania, intended to preserve the recollection of olden time, and to exhibit society in its changes of manners and customs, and the city and country in their local changes and improvements,* Vols. I–III (Philadelphia: Edwin S. Stuart, 1887, Willis P. Hazard, 1905).

[12] *Washington Review and Examiner* (Washington, Pennsylvania: Monday, 5 Aug 1822), 3. The amount was the equivalent of approximately $303,700 in 2022.

> Thus the Citizens, with pleasure, may see the consummation of this stupendous work, which has succeeded in all its parts, more than one-fifth beyond the calculations of its projectors, and is, perhaps, a unique instance of so great a water power any where known, upon such simple principles.[13]

No sooner had the Watering Committee opened the water-powered system to the public in the summer of 1822 than it began attracting growing numbers of visitors who found the operation within the Mill House to be a thrilling spectacle.[14] It was, as we would call it today, a multi-sensory experience—the sight of the wide, cylindrical breast wheels rotating, water cascading through their interiors, the circulating pitman arms on the sides of the wheels pushing the pumps' drive shafts back and forth, the sound of the water falling through the wheels and surging through the pumps, the scent of fresh water aerosolized in the air, the feeling of cool, moist air on the face.

With all of that, though, what struck some as surprising was how quiet the operation was.

> …[W]ith the exception of the water rushing on the wheels, the whole operation of forcing up daily millions of gallons into the reservoirs on the mount, and thus furnishing in abundance one of the first necessaries of life to an immense population—was performed with less noise than is ordinarily made in working a smith's bellows![15]

Outside of the Mill House, just a few feet away, one couldn't tell any of this was going on. Even before the grounds were beautified, they provided a lovely place to simply amble in the

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[13] "Fairmount Water-Powered Works, Opening," *Poulson's American Daily Advertiser* (26 Dec 1822).

[14] Watering Committee, *1822 Annual Report* (9 Jan 1823), 6. The Annual Report states that the Watering Committee intended to construct a mezzanine along the length of the interior of the Mill House, from which all of the breast wheels and pumps could be viewed. Subsequent Annual Reports (1823 through 1825) do not mention the actual construction, but it does appear in published descriptions and depictions.

[15] Thomas Ewbank, *A descriptive and historical account of hydraulic and other machines for raising water, ancient and modern, with observations on various subjects; including the progressive development of the steam engine,* Twelfth Edition (New York: Greeley & McElrath, 1847), 301. Ewbank would become Commissioner of the United States Patent Office nine years later.

fresh air. A person could stroll along the promenade on the Forebay side of Mill House, meander along the river, or wander out along the top of the Mound Dam to the Pier at its end and view the water coursing over Fairmount Dam. By the time the initial operation was completed in December of 1822, the more energetic visitors had already begun using the workers' pathways to climb to the crest of the Fairmount Reservoir in order to take in the magnificent views of the Schuylkill River and surrounding area.[16]

Inside and out, the Fairmount Water Works was much more than an impressive place to visit—it was perceived as ample proof of the ascendency of America itself. This impression only intensified as the grounds were systematically improved.

In 1824 the Marquis de Lafayette, who had contributed so much as one of George Washington's generals during the War for Independence,[17] returned to the United States and was received by throngs of people as he toured several cities. He visited the Fairmount Water Works that year and was so impressed he insisted on seeing it again when he circled back to Philadelphia the following year. For the public this served to cement Fairmount with American achievement. Lafayette's secretary recorded the visits in his journal:

> It was the intention of General Lafayette to embark before the return of the stormy season: but before leaving the soil of America, he still wished to perform several engagements that he had made in different cities… It was already the middle of July, and therefore scarcely two months remained for the execution of his plans…but I will stop a moment in Philadelphia, to see the Water Works and to attend an entertainment given by the little Republic of Schuylkill to the Guest of the Nation.

[16] *Berks and Schuylkill Journal*, Vol. 7, Issue 23 (Reading, Pennsylvania, 2 Nov 1822), 3.
[17] Lafayette led troops in numerous battles, was wounded in the Battle of Brandywine (just west of Philadelphia), shared in the privations of the troops at the Valley Forge encampment, and managed to sail once to France to lobby for increased assistance to the American cause.

> During our first visit to Philadelphia [in 1824], we had visited the fine hydraulic machine established on the Schuylkill, to furnish water to a population of 120,000 souls; and had been struck with the simplicity of its mechanism, its wonderful power and the elegance and good taste of the building which incloses [*sic*] it. But being then a little pressed for time, we had been only able to take a hasty look, without entering into the details; and it was to supply our want of information that we returned a second time [in 1825], with the committee appointed to superintend and direct the establishment.
>
> All these details were heard with lively interest by General Lafayette, who expressed his satisfaction and his admiration, by saying that the hydraulic machine of Philadelphia he regarded as a perfect model of the American Government, in which are found at once simplicity, economy and power. Just as he was going to retire, Mr. Lewis, president of the committee, offered him, in their name, a model of the machine, and a vertical section of the building, beautifully executed in mahogany; which the General greatfully [*sic*] received, assuring Mr. Lewis that he should enjoy real pleasure in exhibiting it to his friends in Europe, as a proof of the mechanic arts in the United States.[18]

Philadelphians and out-of-towners alike encouraged their fellow citizens to visit the Fairmount Water Works. The nearby *Berks and Schuylkill Journal* advised its readers they would not be disappointed:

> The Citizens and Strangers who wish to view the perfect manner in which these works are executed, and to observe with what apparent ease and facility this prodigious exertion of power is produced, as it were by its own efforts, will be amply gratified by a ride or walk of two miles to the top of the basin, commanding a beautiful view of mountains, works, and meandering streams on the west; and of the plans on the east, covered with the buildings of

[18] Auguste Levasseur, *Lafayette in America in 1824 and 1825: Or, Journal of Travels in the United States,* Vol. II (New York: White, Gallaher, & White, 1829), 251ff. Durrett Collection, The University of Chicago Libraries.

this immense city.[19]

In an effort to accommodate the growing number of visitors and help protect the cleanliness of the water supply, City Councils in 1826 decided to fund the creation of a park-like setting around the grounds at Fairmount.[20] A year earlier the Watering Committee had already begun to make the facility more welcoming. You'll recall that one of their own, William Rush, was a well-known sculptor.[21] In 1825 the Committee commissioned from Rush two sculptures,[22] one for each of the Mill House's two entrance portals which faced the Forebay. Rush carved them out of cedrela—Spanish cedar[23]—and had them painted white.[24] The Committee placed *Allegory of the Schuylkill River in Its Improved State,* depicting the Schuylkill River as a mythological river god in chains, atop the North Entrance Portal. *Allegory of the Water Works,*[25]

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[19] *Berks and Schuylkill Journal,* Vo. 7, Issue 23 (Reading, Pennsylvania: 2 Nov 1822), 3.
[20] Resolution of 14 Sep 1826 of Councils, *Report, Joint Committee of the Select and Common Councils, Re. Conferring with owners of the property, bordering on that of the Corporation at fair mount [sic],* 28 Sep 1826, City of Philadelphia Archives.
[21] Rush has been called "the first major American sculptor." See The Library Company of Philadelphia, <www.librarycompany.org/artifacts/sculptors_rush.htm>, accessed 28 Nov 2017.
[22] Watering Committee, *1825 Annual Report* (12 Jan 1826), 10. Line item lists $200.00 paid to William Rush for "carved figures." See also *Watering Committee 1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works").
[23] Files of Philadelphia Museum of Art. Species of wood identified by R.C. Koeppen, Botanist, Center for Wood Anatomy Research, Forest Products Laboratory, Madison, Wisconsin, consulting for Philadelphia Museum of Art (date unknown, possibly 1978–1980). See also Martin Chudnoff, "Cedrela," *Tropical Timbers of the World,* Center for Wood Anatomy Research, USDA Forest Service, Agricultural Handbook No. 607 (1984), <www.fpl.fs.fed.us/documnts/TechSheets/Chudnoff/TropAmerican/html_files/cedrel1new.html>, accessed 11 Jul 2022.
[24] Watering Committee, *1825 Annual Report* (12 Jan 1826), 10 (payments made 2 May and 1 Jun 1825); and Committee on Water, Bills Received, 1804–1854, R.S. 120.43, bill dated Mar 1825 (7 May 1825), City of Philadelphia Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor,* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 174. A man named George Swope charged $10 to paint both of the sculptures with five coats of paint.
[25] Committee on Water, Bills Received, 1804–1854, R.S. 120.43, bill dated Mar 1825 (7 May 1825), City of Philadelphia Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor,* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 40ff, 172ff; Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: Pennsylvania Museum of Art, 1937), 57f, plates 49 and 50. Since the 19th Century, the names used here have been the names by which these two sculptures have generally been known; these remain the names by which they are usually catalogued today. They are derived from Rush's invoice; he identified them as "(1) One male river figure Emblematic river Schuylkill in its improved state (2) one female Ditto Emblematic of the water works." Henri Marceau erroneously identified them, respectively, as "The Schuylkill Chained" and "The Schuylkill Freed" in his 1937 catalogue of a Rush exhibition the same year at the Pennsylvania (now Philadelphia) Museum of Art. Since that time, Marceau's names are sometimes seen, but they do not reflect Rush's own description. See also

depicting the Fairmount Water Works as a reclining classical woman effortlessly forcing the river to work for her, was placed atop the South Entrance Portal.[26] Situated so prominently, where no one could fail to observe them, the two sculptures served to reinforce the idea that this was a place where nature was improved, where elemental forces had been bent to the will of man for mankind's benefit.

The Watering Committee in 1828 built the Wood Cliffside Stairs, a steep stairway to the crest of Fairmount Reservoir. At the same time the Mercury Pavilion, a circular, open-sided, lattice-roofed, gazebo, was constructed beside the stair at a point about two thirds of the way up.[27] The following year another sculpture by Rush and his son, of the eponymous courier delivering a message to the gods, was carved from cedrela[28] and installed at the peak of its roof.[29] Here sightseers could pause in their climb and enjoy the view overlooking the river and the water works. Those who persisted all of the way up the Wood Cliffside Stairs were rewarded with a commanding view from the top of Fairmount. A Brooklyn newspaper described it:

> After satisfying the eye with whatever is worth seeing at the base of the mountain, you ascend by a zig-zag stairway to its summit, from whence a lovely view opens to the eye. On one side stretches the romantic Schuylkill, through mountain passes, overhung with stately forest trees, its banks decked with pleasant villas, until it is lost in the distance; on the other side is spread out in sober majesty the beautiful, the *venerable* city of "Brotherly Love"—this

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Charles Coleman Sellers, "William Rush at Fairmount," *Sculpture of a City: Philadelphia's Treasures in Bronze and Stone*, Nicholas Wainwright, Ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 11ff.

[26] Watering Committee, *1825 Annual Report* (12 Jan 1826), 10. The two sculptures were executed by Rush and his son, John Rush. By this time Rush was nearing 70 years of age.

[27] Watering Committee, *1828 Annual Report* (22 Jan 1829), 10; and Watering Committee, *1829 Annual Report* (11 Feb 1830), 9. See also Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"). Annual Report for 1849 specifies construction occurred in October of 1828.

[28] Spanish cedar. See description at Mercury, 311-1993-1 (8 Aug 2006), archives of Philadelphia Museum of Art.

[29] Watering Committee, *1829 Annual Report* (11 Feb 1830). Rush and his son were paid $60 for the sculpture on 3 Feb 1829.

> affording at a glance the diversified scenery of hill and dale, river and rivulet, lofty forest trees, green fields and lowing and bleating herds; of streets and squares "long drawn out;" of towering steeples and swarming denizens who pour in crowds through countless avenues and streets.[30]

Recognizing the need for ongoing improvements, the Watering Committee in 1835 restated its intention to provide a "gradual addition to the ornamental part of the works, so as to make them not only important for their utility, but to hold their rank as a master work in hydraulics."[31] The same year a marble sculpture called *Diana, the Huntress* was installed above a spring located just south of the Forebay.[32] Messrs. Foster and Taylor described the spring and *Diana*:

> Farther on, and at the very foot of the stairs which lead to the top of the Reservoir, is an old Roman fountain with the pure ice-cold water running like a twisted glass pipe out of the mouth of an amiable-looking but somewhat rigid face, as it is made of stone, and not very smoothly chiseled. This delicious little fountain is armed with a bright tin cup, which stands on the little trough-entablature in conscious security from dents or bruises: for who would be so barbarous as to abuse the stranger's cup at the fountain? No, no, thank heaven, there is nobody in Philadelphia quite rowdy enough for that! This fountain is surmounted by a spirited but coarse statue in marble of Diana, bow in hand; and as you stoop to drink you may if you please kiss the naked knee of the chaste goddess, without frown or reproof from her Crescentship.[33]

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30 "Correspondence of the Star, Philadelphia, July 23, 1843," *Brooklyn Evening Star* (Brooklyn, New York: Wednesday, 26 Jul 1843), 2.
31 Watering Committee, *1835 Annual Report* (28 Jan 1836), 9f.
32 Watering Committee, *1832 Annual Report* (14 Feb 1833).
33 George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography,* Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 66. Unfortunately, public drinking cups like that described here were unrecognized means of spreading contagious diseases.

Complementing the Wood Cliffside Stairs, extended walkways up and across the slopes of Fairmount were constructed[34] and became favorite destinations in their own right. A promenade was constructed around the reservoir, with benches placed at appropriate intervals. As a visitor circled the reservoir, the view from this height progressively revealed a panorama of the Schuylkill River, the Fairmount Dam and locks of the Schuylkill Navigation system, the Fairmount Water Works, the nearby district of Spring Garden, and in the distance the City of Philadelphia.

The Wood Cliffside Stairs required a certain amount of regular maintenance. There is documentation they were entirely repainted in a single season at least once, although this was probably a regular necessity.[35] After becoming increasingly dilapidated[36] they were reconstructed in 1846[37] along slightly more robust and decorative lines. Despite the convenience, however, climbers didn't always return the way they ascended. George Foster and George Rogers Taylor, for example, related their own poorly chosen alternative:

> If you are fond of getting up in the world, let us mount these broad heavy planken stairs, it is not above half a mile of this sort of work to the top of the Reservoir, where we shall be rewarded for our labor by a tolerably large green washbowl filled with water, and a walk in the keen sunshine round its graveled brim. Down the outsides, at various intervals, walks are also cut round the reservoir, and a few of them are partly shaded. …
>
> But we will descend by this wild and craggy woodpath that leads through the bushes, zig-zag down the stony declivity, until we reach the edge and find it necessary to take a leap of eight or ten feet to reach the bottom, at the risk of spraining an ancle [*sic*] or breaking a limb.

[34] Watering Committee, *1836 Annual Report* (5 Jan 1837), 26.
[35] Watering Committee, *1835 Annual Report* (28 Jan 1836) 9f, and Watering Committee, *1836 Annual Report,* 5 Jan 1837, 27. Line item on page 27 of 1836 Annual Report lists $33.89 paid "for painting pavilion and reservoir stairway."
[36] Watering Committee, *1845 Annual Report* (8 Jan 1846), 6.
[37] Watering Committee, *1846 Annual Report* (14 Jan 1847), 6.

> So much for leaving the plain beaten track and going off upon unknown and doubtful paths.[38]

Shortly after the Centre Square Engine House was demolished in 1829,[39] Rush's *Allegory of the Schuylkill River*[40]—originally installed there in 1809[41]—was brought to Fairmount and placed at the foot of the cliff at the southeast corner of the Forebay. With her gleaming white paint and streams of water, the figure of a female figure holding an American bittern on her shoulder stood out against the dark rock of the bluff.[42] She was almost as memorable in her new location as she was at Centre Square. A reporter from Massachusetts described her:

> …[I]n a kind of recess in the rock, amid wild shrubs and plants, that sling by the crevices, is another female figure, unknown in antique song, but far more deserving to be sung in modern, supporting on her shoulder a water fowl, throwing from its open beak a jet, which in its falling, completely envelopes her as with a veil of crystal. She is without question the *Dea loci* [Latin, lit. "goddess of the place"].[43]

An unknown author of a letter to the editor of a local newspaper wrote admiringly:

> The Nereid, or water nymph still rests midway up the rocky declivity…, her drapery is still entire, and she looks as fresh and beautiful as when first created by the chisel of the young artist. I recollect well when she made her first appearance in the centre square, in the midst of a *jet d'eau* and play of fountains, her form delicate and chaste, and her dress closely begirting her, and appearing to adhere to her from the visible effects of the shower.[44]

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[38] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 66.
[39] Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 47 ("Date of important events…"); Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9.
[40] Often erroneously called "Nymph and Bittern." See Chapter 1 for a discussion of the name.
[41] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9f; Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: The Pennsylvania Museum of Art, 1937), 26ff.
[42] Frances Trollope, *Domestic Manners of Americans* (London and New York: Printed for Whitaker, Treacher & Co., 1832), 210.
[43] *Newburyport Herald* (Newburyport, Massachusetts: Friday, 1 Jul 1836), 2.
[44] *The North American*, Issue 203 (Philadelphia: Monday, November 18, 1839).

Graff began designing the South Garden for the area just downstream of the Engine House in 1829; construction began the following year.[45] Prior to improvement, the rocky hillside of Fairmount dropped steeply to the bank of the Schuylkill River. A 20-foot-high stone masonry retaining wall was erected along the river[46] and the area between the wall and the hillside was backfilled in order to raise the grade to the same level as the entrance to the Engine House.[47] Once level and stable, walkways were laid out, trees, flowers, and grass were planted, and a wood fence was installed atop the river wall.[48] The initial landscaping was completed in 1832.[49]

At the focus of the South Garden was the Central Marble Fountain,[50] completed in 1833;[51] the fountain featured a marble sculpture, *Boy and Dolphin,*[52] designed by Frederick Graff.[53] Its waterplay was installed in 1835.[54] A visiting traveler described the fountain as…

> …a large marble basin with a marble image of a child astride of a large fish and from the

[45] Watering Committee, *1831 Annual Report* (12 Jan 1832), 5.
[46] Watering Committee, *1831 Annual Report* (12 Jan 1832), 5.
[47] Watering Committee, *1831 Annual Report* (12 Jan 1832), 9f.
[48] Watering Committee, *1834 Annual Report* (22 Jan 1835), 9.
[49] Watering Committee, *1832 Annual Report* (14 Feb 1833), 181, published *Hazard's Register of Pennsylvania* (16 Mar 1833), 180ff.
[50] Tenants of Highlands to Watering Committee, 9 May 1832. The letter itemizes $1,200 for a "Marble Bason [*sic*], of the best white marble from the Stockbridge quarries to be made & fixed up at Fair Mount as the plan given," $1,100 for "the best white marble from the Pennsylvania quarries and fixed as above," $1.50 per perch for "the filling in behind the marble work," and $950 for unspecified work to made of "Hitner's Red Stone(commonly called white)."
[51] Watering Committee, *1832 Annual Report* (14 Feb 1833), 180, 181, published in *Hazard's Register of Pennsylvania,* 16 Mar 1833, 180ff. See also Committee on Water, Bills Received, 1804–1854, R.S. 120.43, bill dated 1 Aug 1833, City of Philadelphia Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor,* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 182. A man named Peter Fritz was paid $1,050 for the marble work.
[52] The dolphin is a classical heraldic device. Usually depicted as piscine (fish-like) and fanciful in appearance, as it was here, it is an ancient symbol of water-related safety.
[53] Committee on Water, Bills Received, 1804–1854, R.S. 120.43, bill dated 26 Jul 1832, City of Philadelphia Archives; cited in Linda Bantel, ed., *William Rush, American Sculptor,* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 182. A man named Jesse Williamson charged $250 to execute the sculpture. See also pipe plan of fountain dated 21 Sep 1829 by Frederick Graff and an undated (probably from approximately the same time) sketch of the *Boy and Dolphin* by Graff, both in Graff's scrapbook in the possession of the Philadelphia Museum of Art. See also Watering Committee, *1839 Annual Report* (16 Jan 1840), 13. A person named C. F. Rivenes was paid $30 "for marble figure, for the fountain" on 27 Dec 1839. The precise purpose of the additional work is unknown,
[54] Watering Committee, *1834 Annual Report* (22 Jan 1835), 4. "The Committee not having succeeded in obtaining a suitable design for a fountain to be placed at Fair Mount, propose advertising for plans and estimates, and have embraced a sum which they deem sufficient for the object … in the estimate of the year."

> tongue of the fish, a stream of water is cast up 8 or 10 feet high and comes falling back in the child's face; round it are 4 other tubes, each casting up 4 streams of water.[55]

Some 25 years later, a Boston newspaper reporter described the fountain:

> In the grounds is a fountain, having for a [illegible] cherub or sprite, holding in its tiny arms an infantile dolphin, through whose mouth the water is forced to some considerable height, while the chubby boy, with face beaming all over with smiles, looks up to the heavens through the spray and foam, full of rapture and delight. It is most exquisitely cut and very artistically arranged…[56]

While many thought *Allegory of the Schuylkill River* was the loveliest fountain at Fairmount, some offered a differing opinion. The writer of a local visitors' guide thought that…

> …the most striking object, (if it be between April or October, which is the only time the fountain is running,) is the beautiful jets of water spouting from a marble dolphin's mouth.[57]

Foster and Taylor recounted their impression of *Boy and Dolphin* with tongue planted firmly in cheek:

> Entering a little iron gate, you walk through a small yard ornamented with clumps of fir trees, and containing a pretty jet d'eau, with a sweetly carved white marble boy astride a dolphin from whose mouth the sparkling water spouts into the air. The boy has thrown his head back gracefully, and with his right hand shading his eyes, is watching, with an expression of delighted wonder, the bright stream as it breaks into diamonds and flashes in the sun. This little jet and this marble baby are decidedly the most beautiful things at Fairmount. As a piece of sculpture the statue is in our rude opinion one of the finest things in the country. We have examined carefully the Greek Slave [acclaimed 1843 sculpture by

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[55] James C. Brandow, "A Barbados Planter's Visit to Philadelphia in 1837: The Journal of Nathaniel T. W. Carrington," *Pennsylvania Magazine of History and Biography*, Vol.106, No. 3 (1 Jul 1982).
[56] *Boston Evening Transcript* (Boston, Massachusetts: Thursday, 29 Aug 1861), 1.
[57] *Philadelphia As It Is: The stranger's guide to the public buildings, institutions, and other objects worthy of attention in the City of Philadelphia and its environs* (Philadelphia: Geo. S. Appleton, 1845).

> American Hiram Powers] and stood before it hour after hour, trying to see in it the ideal of beauty and grace and tenderness; but we confess, heathen that we are, to have been more truly delighted and attracted by the far rougher and less finished statue of this little Triton mounted on his dolphin. We know of course that we are a barbarian and a bad Christian, and all that sort of thing. But we can't help it. So there's an end of the matter.[58]

In 1836 the Watering Committee purchased additional land between the south end of the South Garden and the Colossus Bridge which crossed the Schuylkill River just downstream. It extended the high, fence-topped[59] masonry river wall south to the bridge and raised the grade behind the wall with back fill as was done with the first portion, thereby lengthening the South Garden nearly to the bridge.[60] By the next year it had been finished and landscaped.[61] Extending the wall to the bridge allowed the construction of the Esplanade—a low strip of tree-lined walkway along the river below the South Garden at the foot of the wall. With access at the north end via the lower level of the Engine House and at the south end via a stairway near the bridge, this additional landscaped area gave visitors a way to stroll close to the river. A British traveler wrote about the Esplanade in particular:

> The rich and varied prospect from the esplanade, of the river, and scenery above and below the dam on the Schuylkill, is most lovely; and accordingly this charming spot, with its fountains, avenues, and foliaged recesses, is the fashionable promenade of the citizens and their wives and families.[62]

In 1838 several hundred trees were planted on the embankments surrounding the

[58] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 65f.
[59] Watering Committee, *1836 Annual Report* (5 Jan 1837), 27.
[60] Watering Committee, *1836 Annual Report* (5 Jan 1837), 16.
[61] Watering Committee, *1837 Annual Report* (1 Jan 1838), 3.
[62] Lieutenant-Colonel [Burrows Willcocks Arthur] Sleigh, *Pine Forests and Hacmatack Clearings; or, Travel, Life, and Adventure in the British North American Provinces* (London: Richard Bentley, 1853).

Fairmount Reservoir in order to control erosion and prevent slides.[63] One Philadelphian described the salutary effect of the improvements:

> One of the pleasantest visits a man can pay in Philadelphia on a hot day, is to the water-works at Fair-mount, on the Schuylkill: the very name is refreshing with the mercury at 96° in the shade; and if there be a breeze in Pennsylvania, you will find it here. No city can be better supplied with water than this; and I never looked upon the pure liquid, welling through the pipes and deluging the thirsty streets, without a feeling of gratitude to these water-works, and of respect for the pride with which the Philadelphians regard their spirited public labour. They have evinced much taste, too, in the quiet, simple disposition of the ground and reservoirs connected with the machinery…[64]

The two steam engines, idle since the autumn of 1822, were sold off on 10 May 1832 and quickly removed. When the engines were first shut down the Watering Committee had intended to hold them in reserve, but the water-powered system proved so successful that they were never needed. The Watering Committee offered the engines for sale but they had so deteriorated from lack of use and maintenance into such a state of disrepair that they failed to attract any buyers.[65] In the end they were sold for scrap at public auction for $5,525.75.[66] The engines' ascending main to the reservoir was abandoned in place.

Their removal of the steam engines left the Engine House in such bad shape that the

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[63] Watering Committee, *1838 Annual Report* (31 Dec 1838), 19; published as Appendix XVIII to *Journal of the Common Council of the City of Philadelphia, 12 Oct 1838–3 Oct 1839*, 17ff. See also Watering Committee, *1832 Annual Report* (14 Feb 1833), 182, published *Hazard's Register of Pennsylvania* (16 Mar 1833), 180ff. The Annual Report for 1832 mentions two embankment slope failures.
[64] Tyrone Power, *Impressions of America: During the Years 1833, 1834, and 1835*, Vol. I (Philadelphia: Carey, Lea & Blanchard, 1836).
[65] Watering Committee, *1831 Annual Report* (12 Jan 1832), published in *Hazard's Register of Pennsylvania*, Vol. IX, No. 6 (11 Feb 1832), 91.
[66] Watering Committee, *1832 Annual Report* (14 Feb 1833), published in *Hazard's Register of Pennsylvania*, Vol. XI, No. 11 (16 Mar 1833), 170, 172 (erroneously numbered 180, 182); and Frederic Graff, Jr., *Notes Upon the Water Works of Philadelphia, 1801 to 1815* (Philadelphia: 8 Jun 1876), p. 6. The Annual Report lists the sale price as $5,523.75; Graff, Jr.'s, *Notes* specifies 10 May 1832 as the date of sale, with removal "soon after." The amount was the equivalent of approximately $190,300 in 2022.

Watering Committee initially recommended it be demolished.[67] In 1832 City Councils decided to instead convert it into a refreshment stand for the visitors thronging the grounds.[68] This was begun in 1834 and completed a year later.[69]

The necessary renovation work turned out to be more substantial than was expected.[70] Although the Engine House looked like a multi-story building from the outside, this was in fact a bit of architectural theatre, originally designed to conceal and protect the two steam engines and the pumps they drove. Despite its appearance to the contrary, it was in fact a hollow shell—one large open space from below ground to the peak of the roof trusses—necessary to provide space for the engines and their attendant machinery and workers. In addition, many of the load-bearing supports for the engines had been critical to the structural integrity of the building itself. Without them the entire internal arrangement had to be reconfigured. Compounding the issue was the fact that the Engine House had been rather neglected for the past twelve years since the steam engines were shut down during the shift to water power.

A main floor and a second floor were constructed. In a clever bit of architectural engineering slight-of-hand, the second floor was suspended from the roof trusses above by five vertical wrought iron rods, each approximately twelve feet long, connected to a transfer beam laid across the bottom chord of the trusses. This allowed the central room on the main floor to be a large space free of columns. Above the central room on the main floor a wide barrel-vaulted ceiling was created and finished in lathe and plaster. What had been the north and south boiler

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[67] Watering Committee, *1832 Annual Report* (14 Feb 1833), published in *Hazard's Register of Pennsylvania,* Vol. XI, No. 11 (16 Mar 1833), 172 (erroneously numbered 182).
[68] Watering Committee, *1833 Annual Report* (23 Jan 1834), 125f, published in *Hazard's Register of Pennsylvania,* (unknown date), 125ff. Councils appropriated $3,500 for the renovation.
[69] Watering Committee, *1835 Annual Report* (28 Jan 1836), 9f; and Watering Committee, *1852 Annual Report* (6 Jan 1853), 48.
[70] Watering Committee, *1834 Annual Report*, (22 Jan 1835), 4.

sheds were converted into dormitories for workmen.[71] On the exterior, the space between the river wall and the building's west foundation wall was enclosed and a columned porch overlooking the Schuylkill River was constructed.[72]

Prior to the addition of the second floor, the roof trusses in the peak of the Engine House had been virtually inaccessible. After the renovation, however, they became a handy place for workers to leave something behind that was hidden from most eyes. Shortly after the building was renovated, workers began to paint their initials and the year on the beams of the roof trusses.[73] The earliest graffito with a legible, verifiable date reads, "W.F.S. 1842 May 16." This practice continued throughout the nineteenth and twentieth centuries.[74]

When the renovation was completed, the Engine House was opened as a "Public Saloon." Benches were provided so that families and individuals could relax while visiting the Fairmount Water Works. The entire Engine House conversion project was a fine early example of what would today be called adaptive reuse.

A columned shelter was constructed in 1835 on the Pier at the end of the Mound Dam; a great eagle at its peak, carved by William Rush's son John Rush,[75] lent the structure its name—the Eagle Pavilion.[76] The pathway to it along the top of the Mound Dam was curbed and paved with bricks.[77]

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[71] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 7f.
[72] Watering Committee, *1835 Annual Report* (28 Jan 1836), 4, 9f.
[73] A. Leonard Pundt, *Fairmount Water Works Engine House Roof Truss Level: Photographic Documentation of Historic Workers' Graffiti* (Philadelphia: 13 May 2016).
[74] The roof truss level of the Engine House is difficult to access and has never been open to the public.
[75] Committee on Water, Bills Received, 1804–1854, R.S. 120.43 (3 Nov 1835), City of Philadelphia Archives, cited in Linda Bantel, ed., *William Rush, American Sculptor,* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982), 186. John Rush charged the Watering Committee $30 for the pavilion's cap, $90 for the eagle and its base, and $10 for blacksmithing and painting.
[76] Watering Committee, *1835 Annual Report* (28 Jan 1836), 9f; and Watering Committee, *1852 Annual Report* (6 Jan 1853), 48.
[77] Watering Committee, *1835 Annual Report* (28 Jan 1836), 4, 9f.

Even with the beautification of the grounds, however, some still favored the machinery as the big draw. The old adage concerning imitation notwithstanding, there are those who consider satire to instead be the sincerest form of flattery. Enter again Foster and Taylor:

> Passing the ice-cream saloon, filled with the b'hoys and g'hals, and stumbling over a row of invalids [loafers, idlers] seated on the iron benches at the door, and who never will take their legs away, we must go down cellar and look at the six or eight great model water-wheels, turned by the water from the dam of the Schuylkill, to keep the pumps going which feed the immense reservoir that supplies the entire city with water. This part of the establishment is very interesting to all practical minds, as the machinery is the most perfect, the neatest and the most silent you can imagine, performing its work as noiselessly and rapidly as a company of gnomes and water-sprites working under the spell of some potent enchanter. There are two more water-wheels than are requisite, and two are always standing idle, ready to go to work in case of accident to the others. But so thoroughly are they all built that we believe nothing ever did happen to any of them; and the two quiet ones look as if they were tired to death of resting.[78]

As improvements were made, visitors began to rave about the beauty of the Fairmount Water Works. One wrote to his wife back home in Detroit:

> The celebrated works on the Schuylkill, by which the water of the river is raised to the top of an eminence which is elevated far above any house in the city, are beyond all praise. The reservoir upon this eminence includes an area of more than half an acre, and from the power of the works, a city of perhaps twice the extent of Philadelphia, could be supplied from the reservoir. The water of the Schuylkill is of an excellent quality, and…you can readily imagine the luxury in this respect, which is enjoyed by the inhabitants of Philadelphia. The

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[78] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), (1969), 67.

scenery on the banks of the Schuylkill, particularly in the vicinity of the works alluded to, is of the most charming description. Delightful seats, surrounded by various kinds of trees and shrubbery, with gardens containing summer houses, vistas, embowered walks, etc. meet your view in almost every direction, woods sloping gently to the river's edge, by the side of smooth lawns, add to the pleasing variety of the scene; and the Schuylkill, with its noble dam and bridges serves as a most beautiful finish to the foreground.[79]

Nothing can surpass this contrivance in beautiful simplicity of principle.[80]

A Scottish visitor affirmed to fellow travelers:

No stranger should visit Philadelphia without seeing the water-works.[81]

An English traveler asserted:

No one should visit this city without viewing these works on the Schuylkill. … [A]ll who have not seen them, should do so forthwith.[82]

Exclaimed another traveler:

The water-works on the Schuyllkill [*sic*] are probably the finest in the world: they can scarcely be praised too highly for beauty of design, simplicity of construction, and real usefulness.[83]

As one local visitor's guide confidently put it without fear of contradiction:

The first thing a visitor is recommended to do by way of recreation, is to ride out and see the water works. Until he has seen them, he has seen nothing.[84]

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[79] John P. Sheldon to Eliza Whiting Sheldon, 10 Dec 1825, "A Description of Philadelphia in 1825," *The Pennsylvania Magazine of History and Biography,* Vol 60, No. 1 (Jan 1936), 75.
[80] E. S. Adby, *Journal of a residence and tour in the United States of North America, from April, 1833, to October, 1834,* Vol. III (London: John Murray, 1835).
[81] James Stuart, *Three years in North America,* Vol. I (Edinburgh: Robert Cadell, 1833).
[82] Captain Frederick Marryat, *A diary in America, with remarks on its institutions* (London: Longman, Orme, Brown, Green, & Longmans, 1839).
[83] Godfrey Thomas Vigne, *Six months in America,* Vol. I (London: Whitaker, Treacher, & Co., 1832).
[84] *A guide to the Lions of Philadelphia; comprising a description of the places of amusement, exhibitions, public buildings, public squares, &c. in the city; and of the places of public resort and objects of interest and curiosity in the environs. Designed as a pocket cicerone for strangers.* (Philadelphia: Thomas T. Ash and Co., 1837).

People began to flock to the Fairmount Water Works. By 1830, in response to the demand for transportation, private companies had established three omnibus[85] lines, each shuttling passengers to and from Fairmount six times per day.[86] The omnibuses—horse-drawn vehicles, often open-sided, with multiple rows of seats—would pick up passengers at various points in the heart of Philadelphia and typically drop them off near the south end of the Fairmount grounds at a point on Callowhill Street near the eastern end of the Wire Bridge which crossed the Schuylkill River there. The excursion didn't take very long. From the Merchant's Exchange,[87] for example, the two-mile drive took roughly a half hour and in 1839 cost 12½ cents.[88] George G. Foster, writer of a travel guide for visitors, wryly recounted a typical trip:

> Taking any one of the five or six omnibuses which always stand at the Exchange, about to start for Fairmount "in exactly two minutes," you read a newspaper or a book, if you happen to have one about you, or pare your nails, or think, for ten minutes, when the machine starts and creeps up Dock and Third-streets, twists itself round the Ledger Buildings into Chestnut, stops to let the man with a load of brick get out of the way, and mounting the hill slowly past the Franklin House, at length fairly trots off. Whew! but that sentence is a breather! A ride of about [an additional] twenty minutes up Chestnut, out Thirteenth and

[85] Over the years the word omnibus was shortened to "bus," which of course continues in common usage today for the familiar motorized passenger transport vehicle.

[86] *Philadelphia in 1830–1: or, a brief account of the various institutions and public objects in this metropolis. Forming a complete guide for strangers, and a useful compendium for the inhabitants.*, (Philadelphia: E. L. Carey and A. Hart, 1830), 208f, <https://archive.org/details/philadelphiain1800phil/page/n8>, accessed 6 Apr 2019. The text quoted here is also a direct copy of text used in the 1824 edition of this visitor's guide.

[87] Located at 3rd and Walnut Streets.

[88] *A guide to the Lions of Philadelphia; comprising a description of the places of amusement, exhibitions, public buildings, public squares, &c. in the city; and of the places of public resort and objects of interest and curiosity in the environs. Designed as a pocket cicerone for strangers* (Philadelphia: Thomas T. Ash and Co., 1837); Captain Frederick Marryat, *A diary in America, with remarks on its institutions* (London: Longman, Orme, Brown, Green, & Longmans, 1839). *Guide to the Lions…* reports the length of the trip; Marryat reports the distance and cost. The cost is approximately equal to $3.50 in today's dollars.

> along the outskirts of the city to Callowhill-street, brings you to Fairmount.[89]

Philadelphians became famous, perhaps infamous, for pressing visitors as to whether or not they had yet been to Fairmount. A journalist from a Massachusetts newspaper related:

> A stranger in Philadelphia should pay an early visit to Fairmount, that he may give a satisfactory answer to the question that will be put to him by nearly every one that he meets, "Have you seen the waterworks?"[90]

As Foster and Taylor reported:

> If you ask a Philadelphian what is the most beautiful, romantic and magnificent place in the world, he will be sure to tell you, Fairmount; and the chances are that he will tell you so whether you ask him or not.[91]

At least one visitor to Philadelphia found the repeated proddings so irksome that in the end he refused to visit Fairmount.

> The Philadelphians, however, pride themselves far more on their waterworks than on their State House [Independence Hall]. Their *Io Paeans* [Latin, excessive expressions of praise] on account of the former, are loud and unceasing, and I must say, the annoyance which these occasion to a traveller, is very considerable. A dozen times a-day was I asked whether I had seen the waterworks, and on my answering in the negative, I was told that I positively must visit them; that they were unrivalled in the world; that no people but the Americans could have executed such works, and by implication, that no one but an Englishman, meanly jealous of American superiority, would omit an opportunity of admiring their unrivalled mechanism.

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[89] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 23ff. Foster's accounts are humorous but more clear-eyed than most.

[90] *Salem Register* (Salem, Massachusetts: Monday, 13 Dec 1841), 2.

[91] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 65ff.

> There is no accounting for the eccentricities of human character. I had not heard these circumstances repeated above fifty times, ere I began to run restive, and determined not to visit the waterworks at all. To this resolution I adhered, in spite of all annoyance, with a pertinacity worthy of a better cause. Of the waterworks of Philadelphia, therefore, I know nothing, and any reader, particularly solicitous to become acquainted with the principle of this remarkable piece of machinery, must consult the pages of other travellers...[92]

Others, while perhaps initially annoyed, gave in and were glad they did.

> …[I]n the eagerness with which the Americans desire to obtain from foreign visitors of any note, their homage of praise to whatever they can show them of native execution, many persons had asked…Whether they had seen the Schuylkill Water-works? and repeated this question so often, that the traveler…determined not to see it at all, and perversely denied himself a gratification, because he would not be "dictated to by others." Having no such scruples as this, we went often to this favourite place of resort, and were always gratified by our visits.[93]

Fairmount attracted its share of the famous and near-famous. In the latter category, at least in the United States, was British actress and author Frances Trollope (1779–1863). Not finding much to like while she traveled in America,[94] she did however admire the Fairmount Water Works:

> There is one spot, however, about a mile from the town, which presents a lovely scene. The waterworks of Philadelphia have not yet perhaps as wide-extended fame as those of Marley [*Machine de Marly,* the water works on the River Seine which supplied fountains of the Palace of Versailles], but they are not less deserving of it. At a most beautiful point of the

[92] Capt. Thomas Hamilton, *Men and Manners in America,* Vol. 1 (Edinburgh: William Blackwood, 1833).
[93] J. S. Buckingham, *The Eastern and Western States of America*, Vol. II (London: Fisher, Son & Co., 1842).
[94] In fairness, Mrs. Trollope lived and traveled in America (from 1827 to 1831) during a period in her life of financial and marital difficulty.

Schuylkill river the water has been forced up into a magnificent reservoir, ample and elevated enough to send it through the whole city. The vast yet simple machinery by which this is achieved is open to the public, who resort in such numbers to see it, that several evening stages run from Philadelphia to Fair Mount for their accommodation. But interesting and curious as this machinery is, Fair Mount would not be so attractive had it not something else to offer. It is, in truth, one of the very prettiest spots the eye can look upon. A broad wear [*sic*: weir, or dam] is thrown across the Schuylkill, which produces the sound and look of a cascade. On the farther side of the river is a gentleman's seat, the beautiful lawns of which slope to the water's edge, and groups of weeping-willows and other trees throw their shadows on the stream. The works themselves are enclosed in a simple but very handsome building of freestone, which has an extended front opening upon a terrace, which overhangs the river: behind the building, and divided from it only by a lawn, rises a lofty wall of solid limestone rock, which has, at one or two points, been cut into, for the passage of the water into the noble reservoir above. From the crevices of this rock the catalpa was everywhere pushing forth, covered with its beautiful blossom. Beneath one of these trees an artificial opening in the rock gives passage to a stream of water, clear and bright as crystal, which is received in a stone basin of simple workmanship, having a cup for the service of the thirsty traveller. At another point, a portion of the water in its upward way to the reservoir is permitted to spring forth in a perpetual *jet-d'eau*, that returns in a silver shower upon the head of a marble naiad [female water nymph] of snowy whiteness [Rush's *Allegory of the Schuylkill River*]. The statue is not the work of Phidias, but its dark, rocky background, the flowery catalpas which shadow it, and the bright shower through which it shows itself, altogether makes the scene one of singular beauty; add to which, the evening on which I saw it was very sultry, and the contrast of this cool spot to all beside certainly enhanced its attractions; it was impossible not

to envy the nymph her eternal shower-bath…[95]

Already known the world over was Charles Dickens (1812–1870), who was 30 when he first toured the United States with his wife Catherine in 1842:

> Philadelphia is most bountifully provided with fresh water, which is showered and jerked about, and turned on, and poured off, everywhere. The Waterworks, which are on a height near the city, are no less ornamental than useful, being tastefully laid out as a public garden, and kept in the best and neatest order. The river is dammed at this point, and forced by its own power into certain high tanks or reservoirs, whence the whole city, to the top stories of the houses, is supplied at a very trifling expense.[96]

Unknown at the time, but destined to become as famous as Dickens, was Samuel Clemens, later known of course as Mark Twain (1835–1910). At the age of seventeen, while working for a printer in Philadelphia, he related a visit to Fairmount in a letter to his two brothers back home in Missouri:

> Unlike New York, I like this Phila amazingly, and the people in it…. I went to the Exchange yesterday, and deposited myself in a Fairmount stage, paid my six-pence, or "fip," as these heathen call it, and started. We rolled along till we began to get towards the outskirts of the city, where the prettiest part of a large city *always* is…. We arrived at Fairmount. We got out of the stage, and prepared to look around. The hill, (Fairmount) is very high, and on top of it is the great reservoir. After leaving the stage, I passed up the road till I came to the wire bridge which stretches across the Schuylkill (or Delaware, darned if I know which!…). This is the first bridge of the kind I ever saw. Here I saw, a little above, the fine dam, which holds back the water for the use of the Water Works. It forms quite a nice water-fall. Seeing a park at the foot of the hill, I entered—and found it one of the nicest little places about. Fat

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[95] Frances Trollope, *Domestic Manners of Americans* (London, New York: Whitaker, Treacher & Co., 1832), 210ff.
[96] Charles Dickens, *American Notes for General Circulation*, Vol. I, 2nd ed. (London: Chapman and Hall, 1842), 236.

marble Cupids, in big marble vases, squirted water upward incessantly. …

I passed along a pavement by the pump-house (I don't know what else to call it) and seeing a door left open by somebody, I went in. I saw immense water-wheels, etc., but if you will get a back number of the Lady's Book, you will find a better description of the works….

Here was a long flight of stairs, leading to the summit of the hill. I went up—of course. But I forgot to say, that at the foot of this hill a pretty white marble Naiad stands on a projecting rock, and this, I must say is the prettiest fountain I have seen lately. A nice half-inch jet of water is thrown straight up ten or twelve feet, and descends in a shower all over the fair water spirit. Fountains also gush out of the rock at he feet in every direction. Well, arrived at the top of the hill, I see nothing but a respectable-sized lake, which [looked] rather out of place in its elevated situation. I can't say I saw *nothing* else, either:—for here I had a magnificent view of the city.[97]

Water wasn't abundant only at Fairmount. Because of the effectiveness of the water works it was plentiful throughout the settled portion of the city. The visiting Davey Crocket (1786–1836) observed:

Early after breakfast I was taken to the Waterworks, where I saw several of the gentlemen managers. This is a grand sight, and no wonder the Philadelphians ask every one that comes, "have you seen the Water-works?" Just think of a few wheels throwing up more water than two hundred thousand people can use: yes, and waste, too; for such scrubbing of steps, and even the very pavements under your feet, I never saw. Indeed, I looked close, to see if the housemaids had not web-feet, they walked so well in water; and as for a fire, it has no chance at all: they just screw on a long hollow leather with a brass nose on it, dash up stairs, and

[97] Mark Twain to Orion and Henry Clemens, 26 Oct 1853, Mark Twain, Edgar Marquess Branch, et al., eds. *Mark Twain's Letters, Volume 1, 1853-1856* (Berkeley: University of California Press, 1987).

> seem to draw on Noah's flood…[98]

The ample supply of water promised a great advance in firefighting. A British traveler remarked:

> [F]ire has no chance in this city. Indeed, the two elements appear to have arranged that matter between them; fire has the ascendant in New York, while water reigns in Philadelphia. If a fire does break out here, the housekeepers have not the fear of being burnt to death before them; for the water is poured on in such torrents, that the furniture is washed out of the windows, and all that they have to look out for, is to escape from being drowned.[99]

By the end of the 1830s, the Fairmount Water Works had entered the pantheon of American national iconography. It became one of the most recognizable American sites in the early and mid-nineteenth centuries. One of the reasons was the spread of lithography. Invented in 1796 in Bavaria, it was a relatively inexpensive way to reproduce drawings using a stone or, later, a metal plate. A multi-colored process called chromolithography was developed in France in 1837. Beginning in the late 1820s, lithographers began to print and sell copies of local Philadelphia scenes. Fairmount quickly proved to be a consistent, well-selling favorite. Prices were reasonable and copies were sold throughout the United States and Europe. Scenes of the Fairmount Water Works were widely circulated—Fairmount from across the river, Fairmount from the Forebay Bridge, Fairmount from the reservoir, you name it.[100]

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[98] David Crockett, *An account of Col. Crockett's tour north and down east, in the year of our lord one thousand eight hundred and thirty-four. His object being to examine the grand manufacturing establishments of the country; and also to find out the condition of its literature and morals, the extent of its commerce, and the practical operation of "the experiment." Written by himself.* (Philadelphia: E. L. Carey and A. Hart, 1835). Crockett's travels took place in April and May of 1834.

[99] Captain Frederick Marryat, *A diary in America, with remarks on its institutions* (London: Longman, Orme, Brown, Green, & Longmans, 1839.

[100] For example, *A View of the Fairmount Water Works with Schuylkill in the Distance,* lithograph, 37 × 54 cm (John T. Bowen, 1838), Library of Congress, accession 2021670167; *Fairmount Water Works from the Forebay Bridge,* lithograph (1833), Historical Society of Pennsylvania; *Fairmount Water Works from the Summit,* lithograph (1838), Historical Society of Pennsylvania; John Rubens Smith, *A View of Fairmount and the Water-Works,* lithograph (John T. Bowen after John Rubens Smith, 1838), Library Company of Philadelphia.

Lithography was not the only medium employed to satisfy the public appetite for images of Fairmount. Artists also captured Fairmount's scenery in paintings[101] and engravings. Views of Fairmount even appeared on porcelain vases and other *object d'art*.[102] These images enabled great numbers of people to "see" the harmonizing of nature with technology which so many writers were celebrating.

With its combination of publicly accessible machinery, architecture, and gardens, Fairmount earned for Philadelphia a new status as a technically advanced city with respect for the traditional and classical past. For a time in the early and mid-nineteenth century, when people thought of Philadelphia it was Fairmount which first came to mind. In the public perception the image of the Fairmount Water Works signified American progress and came to represent not just Philadelphia but America itself.

Celebration of the Fairmount Water Works was not confined to the literary and visual arts. In 1836 sheet music for the "Fairmount Quadrilles" was published;[103] the cover featured an engraving titled "Fairmount from the First Landing" which depicted a view from the Wood Cliffside Stairs leading up to the reservoir. The image depicts the Engine House and South Garden, with the Central Marble Fountain. In the background can be seen the Upper Ferry Bridge spanning the Schuylkill River.[104]

Until 1838, the Upper Ferry Bridge was one of the features which contributed to the

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[101] For example, Nicolino Visconte di Calyo, *The Schuylkill River and the Waterworks,* watercolor and gouache on paper, 26⅛ × 36¼ inches (c.1835), private collection; John Rubens Smith (attr.), *Fairmount Water Works from the Veranda of Harding's Hotel,* pencil, watercolor, and gouache on paper, mounted on linen, 15 × 22 inches (c.1838), Schwarz Gallery, Philadelphia; George Lehman, *Fairmount Water Works,* watercolor on paper (c.1840), Medium Graphics Collection, Historical Society of Pennsylvania.
[102] *Pair of Vases with View of the Fairmount Waterworks,* porcelain with enamel and gilt decoration, patinated brass handles, 21⅛ in., Tucker Factory (c.1830), Philadelphia Museum of Art.
[103] A quadrille was a popular dance at the time. The sheet music is for piano accompaniment.
[104] John H. Hewitt, "The Fairmount Quadrilles," (Philadelphia: John F. Nunns, 1836). Lester S. Levy Sheet Music Collection, Johns Hopkins University, <https://levysheetmusic.mse.jhu.edu/collection/163/083>, accessed 18 Mar 2016.

attractiveness of the Fairmount Water Works. Not part of the water works itself, it crossed the Schuylkill River just downstream, a little beyond the south end of the South Garden. Constructed in 1811–1812 on the site of an earlier floating bridge,[105] it was as great an engineering achievement as it was a beautiful public landmark. Designed by Lewis Wernwag and commonly known simply as The Colossus, the bridge leapt across the river in a single covered span that narrowed gracefully at its midpoint. At 340¼ feet it was the longest single span in the United States at that time.

On the night of Saturday 1 Sep 1838, however, the bridge was destroyed by an act of arson. The weather had been exceptionally dry since June and by the time of the fire the Schuylkill River was no longer flowing over the overflow portion of Fairmount Dam. The Colossus had been such an important crossing of the Schuylkill River, however, that people risked walking across the top of dam to get from one side of the river to the other until the weather broke nine days later and the river once again flowed over Fairmount Dam.[106]

A replacement was sought that would, like The Colossus, allow for the unimpeded flow of water under the bridge so there would be no negative effect on the water works. Charles Ellet designed and constructed the new Fairmount Bridge. Commonly known as the Wire Bridge and completed in 1842, it was the first significant iron cable suspension bridge in the United States. The only bridge similar in design had been a pedestrian suspension bridge built by Josiah White

[105] The floating bridge was also called the Upper Ferry Bridge; it was carried away by floodwaters in 1810. Prior to the construction of the floating bridge, the site was the location of a ferry called the Upper Ferry or Sheriden's Ferry. Approximately two and one half miles downstream, the Lower Ferry or Gray's Ferry Bridge had been also been constructed at the site of an earlier ferry and then floating bridge. See Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 232.

[106] Watering Committee, *1838 Annual Report*, published in *Journal of the Common Council of the City of Philadelphia, for 1838–1839*, Appendix 18 (Philadelphia: 3 Oct 1839), 19f.

at the Falls of the Schuylkill, upstream from Fairmount, in 1818–19.[107]

Ellet consulted Graff on the design of the bridge.[108] In Graff's written response, he posed questions regarding how the various cable components would be connected to each other and protected from corrosion, as well as how the cable system would be supported by the pylons. Graff also furnished crucial information on the location and composition of the abutments remaining from The Colossus which could be re-purposed to good advantage. He then provided helpful advice regarding the questions which politicians and others might ask so that Ellet would be prepared with ready answers. Interspersed throughout the letter Graff included small hand drawings to illustrate his questions and suggestions.[109]

As with the opening of The Colossus thirty years earlier, there was considerable concern among some Philadelphians as to whether the Wire Bridge would collapse when the temporary wooden supports were removed. The cables held, of course, and onlookers were relieved—some disappointed perhaps. The bridge remained in use from 1842 to 1874.

Visitors to Philadelphia continued to be struck by the abundance of water which Fairmount provided. A British traveler wrote in 1839:

> In the morning every householder is obliged to use a hose, supplied with water from neighbouring plugs, and thus the servants wash the front of the house, the steps, and the pavement before them, and generally water the trees. The effect is most refreshing, and the consequence is, that Philadelphia, for purity and cleanliness, cannot be excelled.[110]

Another Briton marveled:

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[107] Francis E. Griggs, Jr., "Louis Wernwag and the Colossus of 1812," *Practice Periodical on Structural Design and Construction,* Vol. 15, Issue 3 (Aug 2010); Francis E. Griggs, Jr., "The Colossus of the Schuylkill River," *Structure* (Jun 2014), 32ff. White's bridge was sometimes called the Spider Bridge.

[108] Charles Ellet to Frederick Graff, 5 May 1839, University of Michigan, Special Collections Library.

[109] Frederick Graff to Charles Ellet, 9 May 1839, University of Michigan, Special Collections Library.

[110] Lieutenant-Colonel [Burrows Willcocks Arthur] Sleigh, *Pine Forests and Hacmatack Clearings; or, Travel, Life, and Adventure in the British North American Provinces* (London: Richard Bentley, 1853).

The glory of Philadelphia is her water works. Water—water—water—is the constant cry of the stranger. You find it everywhere—at the corners of the streets—in the squares—in every part of the houses. Thirst you never need know. Little iron cups, suspended by a chain, are at your service in all parts of the city, and you have but to turn a cock.[111] Here is a poor loafer actually washing his face—there is a countryman sating his thirst; but look out! or you receive a ducking from that coloured gentleman, who is throwing the water through his hose upon the second story windows, while the sidewalk is running with the cool stream, and the marble steps glisten with their recent washing. Here we pass into a public square,—Franklin, if you please. How cool and delicious the shade, and how delightful is that fountain, sending up a dozen jets, and, as the sparkling water falls into the basin, tempting you to leap the railing and bathe your heated temples in the clear and cool depths. Here let us take a seat, and a fine one too, with arms on which to repose. How refreshing is all this to yonder old men, who have come out to enjoy it and talk of olden times! And then see the sick who have been brought here for an hour, to enjoy the sight and be refreshed. Look at that pale young man with the book—and this lady propped up with pillows while the infant is held at her side, and claps its little hands in glee at the sight. How pleasant is this! How considerate! How Kind! The sick are not forgotten; the weary poor may be refreshed! The warfare of life—the hurry and anxiety of business—the wear and tear of the world, have not caused men to forget the sick chamber, the aching heart, and poverty, often the cause of both. A tithe of the wealth amassed in the course of business, is diverted from private fortunes for the comfort and happiness of the multitude.

Merely introducing water into the city might be sheer selfishness; but the manner in which it is here distributed—the effort that all shall partake of the luxury—and the good taste

[111] Unfortunately, before the wide acceptance of the germ theory of disease, public ladles like these were significant vectors in the spread of many deadly contagions.

> displayed, make the water works the glory of the city.[112]

A long-term visitor refused to take it all for granted:

> No city can be better supplied with water than this; and I never looked upon the pure liquid, welling through the pipes and deluging the thirsty streets, without a feeling of gratitude to these water-works, and of respect for the pride with which the Philadelphians regard their spirited public labour. They have evinced much taste, too, in the quiet, simple disposition of the ground and reservoirs connected with the machinery…[113]

A local newspaper would later favorably compare Philadelphia's per capita supply of water with that of Paris and London:

> But in the distribution and abundance of water from an unfailing source, Philadelphia probably surpasses every city in the world—and property among us has doubtless acquired a just and extraordinary appreciation from the circumstance. We were never more forcibly impressed with these facts than when perusing, a few days since, an able paper on the subterranean city of Paris. Besides the far-famed catacombs, sewerage,[114] &c., the author notices the water-pipes, conduits, and fountains, enlarges on the supply of water to the Parisians, but observes that—at Paris, "there is only water enough to allow each person fifteen gallons a day; at London each person can be supplied with twenty-four gallons; and at Philadelphia with seventy-three gallons."[115]

Visitors increasingly made their way to Fairmount via omnibuses. Of course, not all operators were reputable. Some were not above taking advantage of those from out of town. A

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[112] Captain Frederick Marryat, *A diary in America, with remarks on its institutions* (London: Longman, Orme, Brown, Green, & Longmans, 1839).
[113] Tyrone Power, *Impressions of America: During the Years 1833, 1834, and 1835,* Vol. 1 (Philadelphia: Carey, Lea & Blanchard, 1836).
[114] What is the difference between sewerage and sewage? As was succinctly explained to the author-editor by C. Drew Brown, longtime Public Education Manager at the Philadelphia Water Department: "*Sewerage* is the pipes; *sewage* is what goes in them." Therefore, a network of mains, treatment facilities, and the like is properly called a sewerage system, not a sewage system. C. Drew Brown, Public Education Manager, Philadelphia Water Department, telephone interview with author-editor, 4 Apr 2021.
[115] "The Fairmount Water Works," *Philadelphia Inquirer* (Philadelphia, Friday, 29 April 1853), 2.

local newspaper reported in 1837:

> They often pretend to strangers that they are going to Fairmount, take payment of the applicants for that distance, and then drop them in Chestnut or Market streets, near Broad street, or at some other place short of Fairmount, under pretence of misunderstanding. We advise all strangers thus imposed upon, to complain without delay at an Alderman's office. A few fines will stop this fraud, which has become of frequent occurrence. Every citizen should remember that in complaining of these delinquencies, he acts for the whole community, and multiplies his own securities against imposition.[116]

At about the same time, a visiting traveler confirmed the practice:

> After breakfast [we] took seats in an omnibus for the Fairmount Water Works. The chaps finding we were strangers put us down upwards of a mile short of our destination which we had to walk and inquire our way.[117]

It's not known whether the traveler took the advice of the newspaper and reported the incident.

One of the locations where the omnibuses stopped to drop off visitors to Fairmount and pick up passengers for their return trips was the south end of the South Garden. This was also right at the eastern end of the Wire Bridge, a major crossing of the Schuylkill River. Passengers often alighted onto dusty or muddy places on the side of the roadway, now increasingly torn up by the wheels and horses' hooves of not only the omnibuses but freight carriages and a host of other conveyances, as well as by the feet of pedestrians. This began to cause considerable congestion in this high-traffic area.

A tidy traffic-control solution was implemented in 1847. City Councils authorized the

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[116] *Public Ledger* (Philadelphia, Pennsylvania: Saturday, 15Apr 1837), 2, <www.newspapers.com/image/40276499>.

[117] James C. Brandow, "A Barbados Planter's Visit to Philadelphia in 1837: The Journal of Nathaniel T. W. Carrington," *Pennsylvania Magazine of History and Biography*, Vol.106, No. 3, (1 Jul 1982), <https://journals.psu.edu/pmhb/article/view/43836>.

Watering Committee and the Spring Garden District Commissioners[118] to trade two triangular plots of ground near the south end of the South Garden next to Callowhill Street.[119] Under the agreement, the District Commissioners also extended Biddle Street to Callowhill Street to form a V-shaped intersection. The plot gained by Spring Garden, situated between Callowhill and Biddle Streets, was paved the following year by the Spring Garden District Commissioners to serve as a stop for omnibuses and a parking area for private carriages.[120] The combination of the off-street facility and the modified street system allowed vehicles to stop without blocking the roadway and made visitor access—both in and out—cleaner, more efficient, and more convenient.

With the plot gained by the City, the Watering Committee completed the South Garden to Callowhill Street at the edge of the eastern approach roadway of the Wire Bridge. A cast iron fence, designed by Frederic Graff, Jr.,[121] and fabricated by the Robert Wood & Co. foundry, was erected parallel to the street and bridge, perpendicular to the river wall.[122] The fence created a formal south entrance to the Fairmount Water Works grounds.[123]

A writer for a national magazine wrote that after arriving by omnibus…

> …The fresh green foliage, the graceful statues, the musical fountains, create a scene of

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118 Recall that the property of the Fairmount Water Works was owned by the City of Philadelphia but it was located in the municipality of Spring Garden.

119 Watering Committee, *1847 Annual Report* (6 Jan 1848), 6.

120 Watering Committee, *1847 Annual Report* (6 Jan 1848), 6; Watering Committee, *1848 Annual Report* (4 Jan 1849), 6f.

121 Design for Cast Iron Railing for Fairmount Water Works, Drawn by Frederic Graff, Jr., 30 Apr 1847. Philadelphia Museum of Art. Date of drawing is little more than two weeks after the elder Graff's death. See also City of Philadelphia Archives, photograph, Folder 1405, No. 35867-A, 25 May 1936.

122 Watering Committee, *1847 Annual Report* (6 Jan 1848), 6; Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); and Watering Committee, *1852 Annual Report* (6 Jan 1853), 48.

123 In a measure of the cachet accorded anything associated with the Fairmount Water Works at the time, the Robert Wood & Co. foundry was able to market the design of the fence and sell reproductions for installation in numerous locations, including the front yard of the Nashville, Tennessee, mansion of James K. Polk, then President of the United States. See *Philadelphia Mechanics* (1847, no day or month). The mansion, demolished in 1901, was called Polk Place.

> enchantment, upon first entering the yard. The viewing of these and the surrounding scenery, and the examination of the immense and perfect machinery by which the water is forced up to the Reservoir, will prepare you for a cool seat and a dish of ice cream in the neat saloon of the swelling-house; after which you can at your leisure mount the steps leading to the pleasant summer-house above you, or clamber up the little mountain, on whose summit rests the Reservoir, a clear and pellucid lake. From this elevation you have a charming view of the city and surrounding country, Girard College, Preston Retreat, the Wire Suspension Bridge (itself an object of curiosity and interest), the Penitentiary, &c., &c.[124]

Despite Fairmount's obvious appeal and the recommendations of visitors and residents alike, many Philadelphians remained apathetic. A local diarist would record:

> It is a curious fact concerning these works, so uniformly visited and extolled by strangers, that…[t]here are at this moment thousands of our citizens who have never visited them, and many of [those who have visited] have been first induced to visit them from hearing them extolled by people at a distance, when they have been travelling on summer tours."[125]

That many Philadelphians were blithely unaware of the international attraction in their midst may seem surprising at first glance, but have things today really changed all that much? Like their nineteenth-century counterparts, many modern-day Philadelphians have never visited Independence Hall, seen the Liberty Bell, toured City Hall, nor sampled the food at the Reading Terminal Market, despite their being awash in publicity for these and many other interesting things surrounding them in their own city—some of which are either inexpensive or entirely free.

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[124] "City Items," *North American and United States Gazette*, Issue, 16, Vol. 110 (Philadelphia: Friday, 10 Sep 1847).

[125] John F. Watson, *Annals of Philadelphia in the olden time; being a collection of memoirs, anecdotes, and incidents of the city and its inhabitants, and of the earliest settlements of the inland part of Pennsylvania, intended to preserve the recollection of olden time, and to exhibit society in its changes of manners and customs, and the city and country in their local changes and improvements*, enlarged, with many revisions and additions, by Willis P. Hazard, three volumes (Philadelphia: Edwin S. Stuart, 1905). Although this history was published in 1905, the account was recorded in 1842.

This state of affairs is not unique to Philadelphia. Many residents of New York City, for example, have not visited the Statue of Liberty nor the Empire State Building and never go near any of the numerous parks strewn across the boroughs there. Human nature seems to change little across the generations.

For those who wished, however, Fairmount provided a lovely setting for relaxation. Years later a local historian would recount:

> We pause and loiter on the elevation, loth to descend from the eminence of so enviable an outlook. Other visitors are pausing also,—reading books in the arbors, watching the racing-shells upon the river, or catching on their brows the fresh hemlock-scented breeze.[126]

Naturally, reading books wasn't the only activity pursued at Fairmount. The garden setting provided an alluring backdrop for a dalliance; it also provided an opportunity for observing those who fooled themselves into thinking they were discreet. The historian continued with a seeming chuckle:

> There are those, too, who consider an arbor on a hill the very place for a little quiet flirtation, as if privacy was nowhere so certain as in such a spot. But getting up on a pedestal is never the safest way to avoid being seen, and the doings on the hill-top may come to be proclaimed on the house-top.[127]

As our sardonic friends, Georges Foster and Taylor, observed:

> Here love is made on the most extensive scale, and life runs gaily by. The very chickens

[126] Edward Strahan, Ed., *A century after: picturesque glimpses of Philadelphia and Pennsylvania, including Fairmount, the Wissahickon, and other romantic localities, with the cities and landscapes of the state. A pictorial representation of scenery, architecture, life, manners and character* (Philadelphia: Allen, Lane, Scott and J. W. Lauderbach, 1875).

[127] Edward Strahan, Ed., *A century after: picturesque glimpses of Philadelphia and Pennsylvania, including Fairmount, the Wissahickon, and other romantic localities, with the cities and landscapes of the state. A pictorial representation of scenery, architecture, life, manners and character* (Philadelphia: Allen, Lane, Scott and J. W. Lauderbach, 1875). Although this account is from later in the nineteenth century, it easily applies to the early history of the grounds of the Fairmount Water Works as well.

that peck a subsistence from the turf, bill and coo, and the wrens and sparrows hop lovingly among the close-cropped clover-tops.[128]

When the Schuylkill Navigation system opened along its entire length in 1825, three years after the water-powered operation at Fairmount began, a packet line was immediately established to ship freight and transport passengers. A one-way trip between Fairmount and Reading aboard the canal boat "Lady of the Lake" took a day and a half and cost two dollars and fifty cents.[129]

By the 1840s steamboats carrying passengers had begun plying the six-mile-long slackwater pool above the Fairmount Dam for more recreational purposes. The boats departed from a wharf built on the east side of the river just above the outer Forebay and traveled as far as Manayunk, often stopping at various places along the way. Foster and Taylor described the pleasant diversion:

> Beyond the wheel-house [Mill House] is a handsome walk [along the top of the Mound Dam], smoothly flagged [paved with flag stones] and lined with quivering linden-trees, leading to a circular summer-house which overlooks the dam, and where you may draw at any time for a fresh breath of air with perfect confidence that the draft will be honored. Across a little branch of the dam [in the outer Forebay] lies a miniature steamboat, looking very much like a hen-coop with a dog-chain attached to its rear. In this little craft you may navigate the calm and peaceful waters of the Schuylkill as far as the Falls (not exactly Niagara) and even to the remote provinces of Manayunk, famous in olden times for Indian baskets, and now for plump girls, and to the mouth of the pretty Wissahiccon [*sic*]. These

[128] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography,* Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 66f.

[129] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. I (Philadelphia: L. H. Everts & Co., 1884), 613.

> excursions are really delightful in the hot dusty weather, and are liberally patronized by those of our "resident population" whose purses are not long enough to reach Cape May or Newport. The sight of the green fields and richly-wooded slopes on either bank of the river, interspersed with pleasant country residences, farm-houses and variegated landscapes, sends a cool thrill of delight along the fevered nerves. In this voyage, too, you pass along the foot of Laurel Hill cemetery, and may stop if you please and ramble for an hour through its flowery paths and meditate among its classic monuments, taking the boat on its return to the Dam.[130]

During the winter, temperatures were low enough to allow another kind of recreation on the Schuylkill River. From time to time the surface of the river would freeze solid and people of all ages would gather to skate on the ice just above the Fairmount Dam. On the afternoon of Wednesday 10 Jan 1849, a large crowd was skating on the river when a section of ice broke away, stranding approximately 150 skaters. The ice had cracked apart after being weakened by ice harvesters. The floe was carried by the current toward the dam accompanied by the screams of the people trapped upon it. Many jumped into the frigid water in an attempt to save themselves. Fortunately the floe was not far from the eastern shore of the river where the water was least deep and some received assistance from onlookers along the bank. At least part of the floe was swept over the dam along with a woman, a fifteen-year-old girl, and a young child. Although they nearly died by drowning and hypothermia, all three were picked up by boats. In fact, all of the stranded were saved with no loss of life.[131]

Of the many accounts of Fairmount during this period, the strangest undoubtedly comes from Philadelphia publisher and illustrator John Sartain (1808–1897). In a later memoir, he

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[130] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), 67f.

[131] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 569.

described a visit to Fairmount years earlier with Edgar Allan Poe during a cloudy, moonless night shortly before the famous author's death. Reading like a passage from one of Poe's own stories, it is worth quoting here in its entirety.

Poe had unexpectedly shown up at Sartain's door one day:

> The last time I saw Mr. Poe was late in [the] year, 1849, and then under such peculiar and almost fearful conditions that the experience can never fade from my memory. Early one Monday afternoon he suddenly entered my engraving room, looking pale and haggard, with a wild and frightened expression in his eyes. I did not let him see that I noticed it, and shaking him cordially by the hand invited him to be seated, when he began, "Mr. Sartain, I have come to you for a refuge and protection; will you let me stay with you? It is necessary to my safety that I lie concealed for a time." I assured him that he was welcome, that in my house he would be perfectly safe, and he could stay as long as he liked, but I asked him what was the matter. He said it would be difficult for me to believe what he had to tell, or that such things were possible in this nineteenth century. I made him as comfortable as I could, and then proceeded with my work, which was pressing.
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> After he had had time to calm down a little, he told me that he had been on his way to New York, but he had overheard some men who sat a few seats back of him plotting how they should kill him and then throw him off from the platform of the car. He said they spoke so low that it would have been impossible for him to hear and understand the meaning of their words, had it not been that his sense of hearing was so wonderfully acute. They could not guess that he heard them, as he sat so quiet and apparently indifferent to what was going on, but when the train arrived at the Bordentown station he gave them the slip and remained concealed until the cars moved on again. He had returned to Philadelphia by the first train back, and hurried to me for refuge.
>
> I told him that it was my belief the whole scare was the creation of his own fancy, for

what interest could those people have in taking his life, and at such risk to themselves? He said, “It was for revenge.” “Revenge for what?” said I. He answered, “Well, a woman trouble.”

Now and then some fragmentary conversation passed between us as I engraved, and shortly I began to perceive a singular change in the current of his thoughts. From such fear of assassination his mind gradually veered round to an idea of self-destruction, and his words clearly indicated this tendency. After a long silence he said suddenly, “If this mustache of mine were removed I should not be so readily recognized; will you lend me a razor, that I may shave it off?” I told him that as I never shaved I had no razor, but if he wanted it removed I could readily do it for him with scissors. Accordingly I took him to the bath-room and performed the operation successfully.

After tea, it being now dark, I saw him preparing to go out; and on my asking him where he was going, he said, “To the Schuylkill.” I told him I would go too, it would be pleasant in the moonlight later, and he offered no objection. He complained that his feet hurt him, being chafed by his shoes, which were worn down on the outer side of the heel. So for ease and comfort he wore my slippers, which he preferred to my shoes as less ill-fitting.

When we had reached the corner of Ninth and Chestnut Streets we waited for an omnibus some minutes, which were passed in conversation, and among the many things he said was that he wished I would see to it after his death that the portrait Osgood had painted of him should go to his mother (meaning Mrs. Clemm). I promised that as far as I could control it that should be done.

After getting the omnibus we rode to its stopping-place, a little short of Fairmount, opposite a tavern on the north side of Callowhill Street, at the bend it makes to the northwest to reach the bridge over the river. At that spot a bright light shone out through the open door of the tavern, but beyond all was pitchy dark. However, forward into the darkness we walked. I kept on his left side, and on approaching the foot of the bridge guided him off to the right by

a gentle pressure, until we reached the lofty flight of steep wooden steps which ascended almost to the top of the reservoir. There was a landing with seats [the Mercury Pavilion], and we sat down to rest. All this time I had contrived to hold him in conversation, except while we were labouring breathless up that long, breakneck flight of stairs.

There he told me his late experiences, or what he believed to be such, and the succession of images that his imagination created he expressed in a calm, deliberate, measured utterance as facts. These were as weird and fantastic as anything to be met with in his published writings. Of course it is altogether beyond me to convey even a faint idea of his wild descriptions.

"I was confined in a cell in Moyamensing Prison," said he, "and through my grated window was visible the battlemented granite tower. On the topmost stone of the parapet, between the embrasures, stood perched against the dark sky a young female brightly radiant, like silver dipped in light, either in herself or in her environment, so that the cross-bar shadows thrown from my window were distinct on the opposite wall. From this position, remote as it was, she addressed to me a series of questions in words not loud but distinct, and I dared not fail to hear and make apt response. Had I failed once either to hear or to make pertinent answer, the consequences to me would have been something fearful; but my sense of hearing is wonderfully acute, so that I passed safely through this ordeal, which was a snare to catch me. But another was in store.

"An attendant asked me if I would like to take a stroll about the place, I might see something interesting, and I agreed. In the course of our rounds on the ramparts we came to a cauldron of boiling spirits. He asked me if I would not like to take a drink. I declined, but had I said yes, what do you suppose would have happened?" I said I could not guess. "Why, I should have been lifted over the brim and dipped into the hot liquid up to the lip, like Tantalus." "Yes," said I, "but that, would have killed you." "Of course it would," said he, "that's what they wanted; but, you see, again I escaped the snare. So at last, as a means to

torture me and wring my heart, they brought out my mother, Mrs. Clemm, to blast my sight by seeing them first saw off her feet at the ankles, then her legs to the knees, her thighs at the hips, and so on." The horror of the imagined scene threw him into a sort of convulsion. This is but a very faint sample of the talk I listened to up there in the darkness.

I had been all along expecting the moon to rise, forgetting how much it retarded every evening, and the clouds hid the light of the stars. It came into my mind that Poe might possibly in a sudden fit of frenzy leap freely forth with me in his arms into the black depth below, so I was watchful and kept on my guard. I asked him how he came to be in Moyamensing Prison. He answered that he had been suspected of trying to pass a fifty-dollar counterfeit note. The truth is, he was there for what takes so many there for a few hours only—the drop too much. I learned later that when his turn came in the motley group before Mayor Gilpin, someone said, "Why, this is Poe, the poet," and he was dismissed without the customary fine. …

I suggested at last that as it appeared we were not to have the moon we might as well go down again. He agreed, and we descended the steep stairway slowly and cautiously, holding well to the hand-rails. Being down I kept this time, on our return walk, on his right side, and did not suffer the conversation to flag. On arriving at the omnibus waiting for passengers at the tavern door I pressed gently against him and he raised his foot to the step, but instantly recollecting himself drew back. I urged him in, and being seated beside him said, "You were saying?" The conversation was resumed, I got him safe home, and gave him a bed on a sofa in the dining-room, while I slept along-side him on three chairs, without undressing.

[In the] morning he appeared to have become so much like his old self that I trusted him to go out alone. Rest and regular meals had had a good effect, although his mind was not yet entirely free from the nightmare. After an hour or two he returned, and then told me he had come to the conclusion that what I said was true, that the whole thing had been a delusion and a scare created by his own excited imagination. He said his mind began to clear as he lay on

> the grass, his face buried in it and his nostrils inhaling the sweet fragrance mingled with the odour of the earth. While he lay thus, the words he had heard kept running in his thoughts, but he tried in vain to connect them with the speaker, and so the light gradually broke in upon his dazed mind and he saw that he had come out of a dream. Being now all right again he was ready to depart for New York. He borrowed what was needful, and I never saw him again.
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> In about a month from this, as near as I can make out, Poe lay dead in a Baltimore hospital.[132]

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Fairmount provided a copious amount of water to the city but it was at times decidedly less than crystal clear. One writer described the fountains as "throwing their cooling streams of amber purity many feet into the air,"[133] perhaps a reference to the Schuylkill River's tendency to be turbid following a storm. As a Boston journalist would later observe, "The Philadelphia water…after a rain, is apt to be muddy."[134] Abundant it may have been, but Fairmount water was, after all, raw Schuylkill River water. More than a few residents would not have been shocked by an account in a local newspaper, likely having had a similar experience or two of their own:

> A gentleman brought to this office yesterday a gill of hydrant water in a vial, which

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[132] John Sartain, *The Reminiscences of a Very Old Man, 1808–1897* (New York: D. Appleton and Company, 1899), 199ff. At the time of the incident he relates, Sartain was age 41 and Poe 40. In the paragraphs immediately following the above account, Sartain wrote about the events leading to Poe's death. After describing Poe's assault and Sartain's own conversations with the hospital's attending physician, he concluded: "The accepted statement that Poe died in a drunken debauch is attested by Dr. Moran to be a calumny. He died from a chill caused by exposure during the night under a cold October sky, clad only in the old thin bombazine coat and trousers which had been substituted for his own warm clothing."

[133] George Waterman, Jr., "Sketches by the Way," *The Ladies' Repository, and Gatherings of the West,* Vol. III, edited by Rev. Leonidas Lent Hamline (Cincinnati: J. F. Wright and L. Swormstedt, 1843), 311.

[134] *Boston Evening Transcript* (Tuesday, 6 Aug 1861), 1.

> contained a *nondescript* animal resembling a centipede, by the precise *genus* of which we cannot speak of correctly. We are informed that the animal was near being swallowed by a young and lovely girl, who very fortunately saw her danger in time to avert it. We shall never look at a glass of hydrant water after this without a shudder.[135]

Less than a year later, the editors of the same paper published a letter and response regarding the perceived inattention to the cleanliness of the river itself:

> As the inhabitants of Philadelphia depend upon the water of the Schuylkill for every purpose for which water is wanted, it is important to their health at least, that, so far as may be, that water should be transmitted to them in a condition of purity. But is it so? Let one fact answer. I was informed to day by a citizen in whom I have confidence, that while walking a few days since on the banks of the Schuylkill, between the new bridge and the bridge near Laurel Hill, he counted more than fifty dead cats and dogs, floating in the river! Add to this, the almost innumerable instances in which a certain nameless nuisance is committed without hindrance, in that water, which is intended to be the wholesome and pure beverage of our citizens. That such things will occur at a distance, and are unavoidable, I know; but I contend that it is the duty of the public authorities of this city and county to take care that the very fountains of health shall not be poisoned within their jurisdiction. What say you, Mr. Ledger? [signed,] A WATER-DRINKER.
>
> We say that the allegation about the existence of these nuisances it true, as we have more than once personally witnessed such things. We say further that our authorities are grossly and scandalously negligent of their duty in permitting such abominations; for by a softer term we cannot name them. We admit that they cannot prevent the river from being defiled beyond their jurisdiction; but within that, it is their duty to keep it clean, for they are employed and

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135 "Water," *Public Ledger* (Philadelphia, Thursday, 6 Oct 1836), 4; < www.newspapers.com/image/37267910>, accessed 8 May 2015.

> paid for such purpose. More dirt is probably thrown into the Schuylkill within the limits of this county, than in the whole course of the river besides; and if we take care of our share, the fishes will dispose of much of the rest. These dead horses, &c. &c. rest in the back water produced by the Fairmount dam, and consequently furnish their supplies directly for the reservoirs. Four men, each in a light boat, could easily keep the river clear of floating dirt, for ten miles above the Fairmount dam. They would not be required for more than nine months of the year, and could be hired for about a dollar daily. The whole expense would not exceed \$1500 or \$2000;[136] about one third of the interest on the sum thrown away upon the nonsensical rail road in Market street, or one half of that paid for junketing at the Alms House, and divers other foolish, not to say illegal expenditures.[137]

With increasing residential and commercial activity along the Schuylkill River above Fairmount, some were beginning to recognize that steps would need to be taken to protect the purity of the river's water. An opportunity to preserve open space along the river presented itself when the Lemon Hill estate, a large property atop a bluff along the river's east shore about a half mile above Fairmount, came on the market in 1843. Thomas Pym Cope, longtime Watering Committee member from the Select Council, introduced a bill to form a joint committee with the Common Council to pursue the purchase of the estate. The bill passed both chambers shortly after it was introduced in October and Cope was appointed chairman of the ten-member purchasing committee.[138]

Recall that Lemon Hill was originally part of a large estate owned by Robert Morris.[139] The southern portion included Morris Hill, also known as Fair Mount, which the City of

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[136] The equivalents of approximately \$46,300 and \$61,700 in 2022.
[137] *Public Ledger* (Philadelphia, Pennsylvania, Monday, 31 Jul 1837), 2, <www.newspapers.com/image/40276859>.
[138] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978). Cope's account of the purchase of the Lemon Hill estate may be followed in entries on pages 411, 412, 412ff, 414, 414f, 415, 415f, 417, 418, 4119, 419f, 420, 434, 436, 441, 441f, 442, 443f, and 447f.
[139] As noted earlier, Morris was one of the signers of both the Declaration of Independence and U.S. Constitution.

Philadelphia purchased from one of Morris' sons and the son's business partner in 1812. Henry C. Pratt purchased the Lemon Hill tract in 1799 at sheriff's sale when Morris encountered severe financial difficulties and landed in debtor's prison. Pratt demolished Morris' house but expanded the greenhouse complex and constructed his own large summer house on the property. He named his estate after the numerous lemon and other citrus trees Morris had planted.[140]

When Pratt died in 1836, The Second Bank of the United States held the mortgage on the Lemon Hill estate. It had purchased it as an investment property for $225,000.[141] When the bank later became insolvent, its trustees tried to sell the property, setting an asking price of $250,000[142] in 1843.[143]

John Price Wetherill, the Watering Committee chairman, offered to purchase the property for $180,000, apparently for himself, but was turned down. After no other potential buyers appeared, it became obvious the bank would not see anywhere near the sale price for which it had hoped. On 2 Nov 1843, Cope, negotiating from a position of strength, closed with the bank on a purchase price of $75,000[144]—far lower than either the original asking price or Wetherill's offer. In addition to the lack of other buyers, another factor—likely just as important—worked to Cope's advantage. The agent of the trustees was one of his own nephews, Herman Cope. Having a thorough knowledge of his uncle's upright character, Herman Cope knew that although his uncle would negotiate the best possible deal for the City, he would not attempt to cheat the

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140 Thomas Westcott, *The Historic Mansions and Buildings of Philadelphia* (Philadelphia: Porter & Coates, 1877, 1894; Walter H. Barr, 1895), 376ff; Ryan K. Smith, *Robert Morris's Folly: The Architectural and Financial Failures of an American Founder* (New Haven: Yale University Press, 2014), 182f.
141 The equivalent of approximately $7.2 million in 2022.
142 The equivalent of approximately $10 million in 2022.
143 Thomas Westcott, *The Historic Mansions and Buildings of Philadelphia* (Philadelphia: Porter & Coates, 1877, 1894; Walter H. Barr, 1895), 380.
144 The equivalent of approximately $3 million in 2022.

trustees of the bank.[145]

Nevertheless, Cope confided to his diary that he thought the proposed purchase price was a comparative steal, for two reasons. On the face of it, he believed the actual value of the estate was a great deal more than the agreed upon purchase price. At least as important for the City of Philadelphia in terms of cost, though, was the issue of the flooded portion of the property. The estate covered 52 acres, seven and a half of which had been submerged beneath the elevated water created by the Fairmount Dam in 1822. For some reason, however, Pratt had never filed a claim against the City for compensation for the loss of that portion of his property. In his estimation, Cope believed that if someone else were to purchase the estate, the City would be exposed to the risk of compensating the new owner for upwards of $20,000,[146] a not inconsiderable sum at the time.[147]

Cope wrote that he believed the purchase of Lemon Hill was crucial to "the prosperity of our beautiful City, the health & comfort of its inhabitants."[148] He firmly believed he was rendering the City of Philadelphia "one of the most important services of my life."[149] So anxious was Cope for the City to purchase the estate as soon as possible that he lost sleep over the affair.[150]

One cause for Cope's anxiety was opposition within the joint purchasing committee. Four of the ten members of the very committee created to pursue the purchase of Lemon Hill were

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[145] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 412.
[146] The equivalent of approximately $800,400 in 2022.
[147] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 413.
[148] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 412.
[149] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 412f.
[150] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 412.

opposed to it, led by none other than Watering Committee chairman John Price Wetherill himself. Cope suspected that Wetherill still had hopes of purchasing the estate for himself and was endeavoring to derail the sale so he could obtain it at the bargain-basement price for which it was going to the City. For the moment, however, Wetherill and the other three were outnumbered four to six. Nonetheless, on 10 Nov, after a contentious meeting during which Cope must have used all his powers of persuasion, the joint committee authorized Cope to complete the negotiation with the trustees and close the deal for the purchase of Lemon Hill, provided the price didn't exceed $75,000.[151]

Three days later Cope completed the negotiation with the trustees of the Bank of the United States. That evening, after a failed last-minute attempt to scuttle the sale by Wetherill and his faction, the joint committee voted to authorize Cope to formally accept the offer of sale for the agreed price of $75,000. This Cope did the very next day.

Wetherill next recruited City Solicitor Edward Olmstead and throughout the winter and the next spring, in a further effort to defeat the sale, the group raised a series of objections to the title of the Lemon Hill estate. The objections were not submitted all at once, but one after the other so that it took months to resolve them. Wetherill had apparently used this tactic at least once before, when he made objections to titles of coal-rich properties in Schuylkill County in order to discourage other bidders so he could purchase them himself at prices lower than the market rate. For anyone who knew Wetherill's history, his actions revealed his true motive. They weren't illegal by any means, but they were certainly not scrupulous either. In the case of the Lemon Hill estate, he was clearly acting in his own self-interest and against the best interests of the City he professed to serve.

[151] The equivalent of approximately $3 million in 2022.

Wetherill's behavior became so intolerable for Cope that he refused to attend the annual dinner of the Watering Committee at Fairmount in April 1844. Cope vented in his diary:

> If I had no other objection, I cannot be reconciled to be the guest of a com[mittee] at the head of which J.P. Wetherill is placed. It is a serious evil to the City to have such an irritable, intriguing [scheming], unfair man at the head of that important com[mittee]. It would be a strong temptation indeed that could induce me to leave a comfortable home, amid such a storm as prevails today, to eat dinner two miles off.[152]

In July 1844 the City Solicitor attempted to declare the City of Philadelphia ineligible to purchase and hold property in the Spring Garden district. This was a bizarre assertion indeed, since the property of Fairmount Water Works itself—owned by the City of Philadelphia since its purchase in 1812—was situated squarely within the district of Spring Garden. Was the City's chief lawyer prepared to risk delegitimizing the City's ownership of Fairmount in a reckless attempt to squelch the procurement of Lemon Hill? Fortunately nothing came of it.

In the end, all of Wetherill's maneuverings to kill the Lemon Hill transaction were in vain. The deed for Lemon Hill was finally executed on 19 Aug 1844 and the City of Philadelphia paid the trustees the agreed-upon $75,000. The next day the joint committee authorized Cope to make a full report to Councils. Twenty-three days later Cope read aloud in Council:

> The Committee on Lemon Hill have at length the satisfaction to report:
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> "That the Deed of Conveyance to the City for that valuable Estate has been duly executed, the Consideration Money paid & the Deed, together with the other title papers, place in custody of the city Surveyor as provided for by Ordinance.
>
> "Doubts having been expressed as to the validity of the title to this Estate, the Committee felt it to be their duty to consult able & experience counsel on the subject & they accordingly

[152] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 436.

> applied to Horace Binney & Garrick Mallery, Esqrs., for their opinion, who, after a laborious investigation, met & removed every item of objection & the Com[mittee] can therefore with great confidence assure Councils that the title to Lemon Hill is unexceptionable. The opinion of those distinguished Lawyers is deposited with the other papers relating to the Estate."[153]

Cope recorded in his diary:

> The Ordinance passed has caused me no little time & anxiety but which secures to the City a very important benefit. No opposition was made either to the report or to the Ordinance, tho' J.P. Wetherill muttered something in his seat.[154]

On 24 Oct Cope introduced legislation in Select Council to pursue the purchase of some of the property between Fairmount and Lemon Hill, known as the Flat Iron area, fronting approximately 500 feet along the Schuylkill River. The bill passed unanimously in Select Council but was postponed in Common Council.[155] Further acquisition of property for the protection of the water supply would have to wait until a later date.

The purchase of Lemon Hill was a signal event for the City of Philadelphia. What began with the completion of the initial portion of the South Garden in 1832 grew with the addition of Lemon Hill's 52 acres. In 1855 the property would be designated "Fairmount Park." Ultimately the park would expand to an area covering 2,052 acres on either side of the Schuylkill River upstream of Fairmount, with an additional 2,042 acres in the adjoining Wissahickon Valley Park.

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153 Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 443f.
154 Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 443f.
155 Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 447f

Because Frederick Graff's engineering skill was so amply demonstrated by the successful design and operation of the Fairmount Water Works and the entire water distribution system, he became increasingly recognized as an expert in hydraulic engineering and was asked to consult on numerous projects. He consulted on 37 water works and water supply projects, including those of New York City and Boston. For some projects he was asked to render his professional opinion on this or that aspect; for others he provided a wide range of information, including detailed plans and calculations.[156]

Graff participated in two notable experimental investigations, one of which produced a landmark scientific contribution in his field, the other resulting in a remarkable contribution rather outside of his field. Both were conducted in Philadelphia under the auspices of the Franklin Institute.

In the years before the Civil War, engineering was developing into a recognized science. Many professional organizations sprang up in numerous cities. Most failed after a time and were disbanded but one stood out for its success and longevity despite numerous financial and organizational challenges. The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts was founded in 1824, originally for the twofold purpose of providing technical training and education in the sciences and pursuing primary scientific investigation. Seeking to meet the needs of young, lower- and middle-class engineers (or mechanics as they were then called) it provided lectures and formal classes at low or no cost for a flat annual membership fee.

Today the Franklin Institute is a popular public science museum in Philadelphia, but its

[156] Henry Simpson, *The Lives of Eminent Philadelphians* (Philadelphia: William Brotherhead, 1859), 434f; Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 29.

founding aim was to produce engineers and technicians who would design and produce finished goods and the machines to make them by working according to systematic, empirical principles, not rules-of-thumb or traditions of uncertain accuracy handed down within a craft from generation to generation. It also provided a forum for engineers, scientists, and industrialists to meet and exchange information.[157]

The Franklin Institute turned its attention in 1829 to the investigation of water wheels.[158] Although John Smeaton had famously conducted signal experiments on water wheels in the 1750s, he had used scale models.[159] Seventy-odd years later, mill operators still had trouble applying Smeaton's principles to large water wheels. As great an advance as Smeaton's work had been, his results weren't accurate enough for the new demands. Hydraulic engineers suspected the difficulties were due to problems of scale. The organization's ambitious solution was to conduct experiments on full-sized wheels.

An appeal was circulated throughout the country for financial assistance. The managers of the Franklin Institute estimated approximately $2,000 would be needed.[160] In a dramatic display of the widely perceived need for such research, money poured in, in small amounts from individual mill operators, engineers, and factory owners, as well as in larger sums from professional societies and business concerns. Within just a few months enough funds were raised—approximately $1,500[161]—to green-light the project. Accompanying the contributions was something just as important—a variety of suggestions for ways of optimizing the value of

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[157] Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins University Press, 1974), 28ff.
[158] Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins University Press, 1974), 140ff; Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore: Johns Hopkins University Press, 1983), 252ff.
[159] Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore: Johns Hopkins University Press, 1983), 223ff.
[160] The equivalent of approximately $63,700 in 2022.
[161] The equivalent of approximately $47,800 in 2022.

the results.

Frederick Graff, eager to hone the efficiency of the breast wheels at Fairmount, offered the Mill House as a site for the experiments. In 1829, after all, there were still four empty bays where breast wheels and pumps had yet to be installed. More than a few contributors, however, had expressed their opinion that the seven-foot fall at Fairmount would not be sufficient for as thorough an investigation as was desired. Graff and the engineers at the Franklin Institute agreed and instead selected a site at 9th and Vine Streets where James I. Rush and Peter D. Muhlenberg, the steam engine manufacturers whose nearby plant was the successor to Oliver Evans' Mars Works, had donated property for the experiments. Graff and the Watering Committee ran a special-built supply line and the City of Philadelphia provided all of the needed water free-of-charge.

The size of the test rig which was constructed can be gauged by the size of the shed which was built around it to provide protection and workspace—90 feet long by 24 feet wide by 33 feet high. The apparatus was very sophisticated for its time, with a forebay reservoir, afterbay reservoir, and valves for controlling water flow, as well as devices for accurately measuring volume, weight, and time. It allowed for various types and sizes of water wheels and bucket configurations to be alternately installed and tested.

The aim of the investigation was to identify "the mode of applying any given head of water, so as to produce the greatest ration of effect to power expended."[162] In other words, for various situations, which is the most efficient design and configuration of water wheel? Because of the numerous variables involved which made answering this question complicated and difficult, the engineers settled on a common metric—the time it took a measured amount of

[162] *Journal of the Franklin Institute* 12 (Aug 1831), 80; cited in Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins University Press, 1974), 145.

water to raise a given weight to a given height.

Four sizes of wheels were employed, measuring 6 feet, 10 feet, 15 feet, and 20 feet in diameter. Various bucket configurations were used. Seven different chutes applied water from the forebay reservoir to various points on the wheels.

Frederick Graff served on the committee that planned and carried out the experiments. They were conducted from the spring through the end of December 1830, with volunteers manning the equipment. During that time 1,381 trial runs were executed, with each run conducted at least twice for accuracy.

The investigation was a great success. The results were printed in the Journal of the Franklin Institute beginning in March 1831 and continued in later issues. Because of the complexity of the testing and the results, no single specific recommendation was made, but the owner of a mill, say, could determine the efficiency of his operation by looking up the relevant data on the published reports. Millwrights could use the data to design and construct highly efficient wheels tailored to the specific conditions at a client's operation. With Frederick Graff's assistance, the Institute had achieved its goal in making an invaluable scientific contribution to the industrial community as well as providing empirical data crucial to improving manufacturing practices.

The work was recognized for its importance and scope. For example, George Rennie, the acclaimed British engineer acknowledged as one of the greatest living experts on hydraulics at the time, wrote that he himself had "made a great many experiments on the maximum effect of water wheels; but the recent experiments of the Franklin Institute, made on a more magnificent

scale…eclipse everything that has yet been effected on this subject."[163]

In 1830 the managers of the Franklin Institute's board of managers again asked Graff to contribute to another important investigation, in this case that of boiler explosions.[164] Recall that in the early decades of the nineteenth century, boiler explosions were a serious problem. Whether due to incompetence or negligence, the accidents were causing horrific loss of life, especially on steamboats. The Franklin Institute proposed to conduct a series of experiments to identify causes of the accidents and make recommendations. When the proposal attracted Congressional attention, the project became the country's first federally funded experimental investigation. As before, Graff served on the committee which planned and conducted the experiments.

Tests on two custom-built boilers were conducted from 1831 to 1835. Both apparatus were examples of sophisticated equipment, accurately measuring extremely high temperatures and pressures. One was even partially constructed of glass. They were the first of their kind in America. The experiments were inherently dangerous. Although there were numerous explosions—neighbors living near the 12th and Vine Streets location of the facility reported hearing them—there were no injuries. The report that was produced included data and an analysis of root causes which debunked errors, misconceptions, and half-truths commonly held by many boiler operators. It was widely recognized as a landmark contribution to the scientific understanding of materials engineering as well.

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[163] *Journal of the Franklin Institute* 19 (Jan 1835), 57ff, and (Feb 1835), 125ff; cited in Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins University Press, 1974), 147.

[164] Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins University Press, 1974), 170ff.

In 1833, recall, Graff had taken seriously ill as a result of prolonged exposure to the wet and icy elements when attempting to close the canal lock gates at the western end of Fairmount Dam during the ultimately futile struggle to prevent the Schuylkill Navigation Company from wresting control of the Fairmount locks from the City of Philadelphia. His health was never the same afterward.[165] In a letter to the Watering Committee in 1845, in fact, Graff had mentioned "the weak state of my health" as a reason for not attending a particular meeting on an inclement evening.

On 13 Apr 1847, Frederick Graff died at the age of 71.[166] He had served the City of Philadelphia for 48 years, 42 as Superintendant of the City's water works.

Philadelphia mourned Graff's death much as he lived his life—rather quietly and without ostentation. His funeral, however, was attended by the mayor, officers of the City, and the assembled members of both chambers of City Council.[167]

Frederick Graff's life and career is an example of the growth and recognition of the engineer as a reputable professional. Early in his life, engineering was only beginning to be perceived as a profession; the engineer was considered to be of lower social status because he worked with his hands, unlike higher professions like medicine, the law, or the ministry. (Although a doctor works with his hands, for example, his medical analysis was intellectual.) In a letter to his future wife in 1806, the thirty-year-old Graff wrote that although he earned a living

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[165] Henry Simpson, *Lives of Eminent Philadelphians, Now Deceased* (Philadelphia: William Brotherhead, 1859), 434.

[166] Watering Committee, *1847 Annual Report* (6 Jan 1848), 18. "In closing this years [*sic*] Report, your Committee deeply regret the death of the late Superintendent, FREDERICK GRAFF, ESQ., which took place upon the 13th of April last, who for *forty-two* years held that situation; and by his plans and devoted attention to the best interests of the City, and to Fair Mount Water Works, has been of great benefit not only to our citizens, but to the country generally. JOHN P. WETHERILL, *Chairman.* [et al.]" [Caps, small caps, and italics original.]

[167] "Proceedings of City Councils," photocopy of clipping from unknown newspaper (15 Apr 1847). Historical Society of Philadelphia.

with his hands, he would always be able to provide for her.

> … I hope it will not be amiss to be explicit. My situation in life is that of a dependency upon my industry for a genteel livelihood, which by care and assiduity to business I flatter myself I shall always be able to make. As to my character generally, I leave to you to decide by inquiry or other means. Should my proposition be granted by you with the consent of your Parents, I assure you On My Honour My endeavors shall never be wanting when they can be applied for your happiness.[168]

America's earliest engineers like Graff, called mechanics or mechanicians in the early nineteenth century, learned their craft on the job by working on projects such as canals, bridges, or military fortifications. They figured out how to solve problems as they were encountered. In the United States there were no schools that taught engineering until 1817, when Colonel Sylvanus Thayer was appointed Superintendent of the United States Military Academy at West Point by President James Monroe and established engineering as the foundation of the institution's curriculum.[169] Alexander Dallas Bache was a graduate of West Point in these early years and brought his engineering and scientific rigor to the Franklin Institute in 1828. Engineering slowly began to be taught systematically and methodically instead of haphazardly.[170]

Graff began as a builder's apprentice, learned drafting and architecture under Latrobe in 1799 and 1800, and applied his skills to design the Second Bank in Norfolk, Virginia, in 1800. This was followed by his work on South Carolina's Santee Canal in 1801, where he flowered

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168 Frederick Graff to Judith Sweyer, Oct 1806. Mrs. Charles Graff Collection, The Historical Society of Pennsylvania.

169 "Sylvanus Thayer," *West Point in The Making of America*, Smithsonian National Museum of American History, Behring Center, <https://americanhistory.si.edu/westpoint/history_1a1.html>, accessed 2 Jun 2019.

170 Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: The Johns Hopkins University Press, 1974), 149ff.

into what today we would call a civil engineer. When Graff became Superintendent of the Schuylkill and Centre Square Water Works in 1804, constantly repairing the steam engines and pumps and maintaining them in working order, he added to his repertoire the skill set of what we would recognize as the mechanical and hydraulic engineer. This on-the-job training prepared him well for the design, construction, and maintenance of the Fairmount Water Works.

Although most of his career was spent during a time in America when engineering was learned by apprenticing with another engineer and studying great engineering works, Graff valued science and mathematics. A life-long learner, as late as 1835, at the age of 60, he was still eagerly consuming the latest hydraulic engineering theory from France in order to expand his skills.[171]

At around age 50 Graff adopted the courtesy title "Esquire," appending "Esq." to his name.[172] At the time, the term was used to indicate a professional person, not necessarily a lawyer. It signified his high view of his profession, his recognition of its importance, and the seriousness with which he took his work.

A year after Graff's death, the City of Philadelphia erected a monument to him in the South Garden. Designed in the Gothic Revival style and constructed of Pennsylvania Blue Marble[173] by John Struthers & Son of Philadelphia, one of America's foremost marble masons at

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[171] Peter A. Ford, "Charles Storrow, Civil Engineer: A Case Study of European Training and Technological Transfer in the Antebellum Period," *Technology and Culture*, Vol. 34, No. 2 (Apr 1993), 290f. As soon as Graff learned, from fellow hydraulic engineer Laommi Baldwin, of a landmark publication on French hydraulic theory, he ordered a copy. See Charles S. Storrow, *A Treatise on Water-Works for Conveying and Distributing Supplies of Water* (Boston, 1835); Graff to Laommi Baldwin, 6 Apr 1835, Baldwin Collection, ms. 7, box 9, file 1, Baker Library, Harvard Business School, Boston, Massachusetts.
[172] An survey of Graff's correspondence indicates he adopted this practice sometime around 1825.
[173] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 7f. The marble would have been quarried nearby, in either Montgomery or Chester County.

the time,[174] it featured a bust of Graff rendered in white Italian marble[175] by sculptor Hugh A. Cannon[176] and was closely surrounded by a low, white-painted, eight-sided cast iron fence to keep visitors at a respectful distance.[177] It was intended as a permanent memorial, an expression of gratitude for Graff's contributions to the City of Philadelphia at Fairmount. A local newspaper provided a description:

> The monument to the memory of Frederick Graff, the founder of the Fairmount Water Works, authorized by Councils to be erected at Fairmount, was completed on Saturday. As an ornament to the grounds at Fairmount, it will be an attraction for ages to come; as a work of art it must be classed among the gems of sculpture; and as a tribute to the great and good man whose genius and worth it commemorates, it will ever reflect credit upon the municipal rulers of the citizens of Philadelphia.
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> The design is that of a Gothic canopied shrine. … The canopy thus formed serves as a protection to the bust of Mr. Graff, which stands upon an octagon pedestal. … The bust was

[174] Watering Committee, *1848 Annual Report* (4 Jan 1849), 16. Struthers was paid $2,000, in two equal installments on 4 Apr and 10 Aug 1848, and Robert Wood was paid $148.50 on 10 Aug for the surrounding iron fence. See also Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 252, 282, 288; James Albert Wineberger, The Tomb of Washington at Mount Vernon (Washington D.C.: Thomas McGill, 1858), 43ff; and "Struthers, John (1786–1851), Architect/Builder, Marble Mason," *Philadelphia Architects and Buildings,* The Athenaeum, 2019, <https://www.philadelphiabuildings.org/pab/app/ar_display.cfm/127005>, accessed 5 Jul 2019. Originally from Scotland, Struthers was a supplier and designer of much architectural and decorative marble for numerous projects including many in partnership with architect William Strickland. He created the sarcophagi for the re-interment of the remains of President George Washington and his wife Martha at Mount Vernon in 1837.

[175] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 7f. The source of the marble for the bust was likely the famed Carrara quarries.

[176] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 288; "Biography of Hugh Cannon (1814–1881)," *Artprice,* <https://www.artprice.com/artist/195334/hugh-cannon/biography>, accessed 5 Jul 2019. An Irish immigrant, Cannon initially worked for Struthers, later in his own studio. He was listed in Philadelphia directories as a marble mason, sculptor, and carver from 1840 to 1857, likely his years of greatest activity. He sculpted busts of many important figures of his day. See for example Hugh A. Cannon, *Henry Clay* (1838), collection of Pennsylvania Academy of the Fine Arts; Hugh A. Cannon, *Nicholas Biddle,* bust (1838), collection of Pennsylvania Academy of the Fine Arts; "Lot 414: Marble Bust of John Marshall (1755–1835)," *Freeman's Auction* (14 Nov 2018), <www.freemansauction.com/auction/lot/414-hugh-cannon-irish-active-philadelphia-1840-1857/?lot=549129&sd=1>, accessed 25 Sep 2022. See also Hugh A. Cannon, *Self-Portrait,* bust (c.1845), collection of Pennsylvania Academy of the Fine Arts.

[177] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 2, 11, 16, 31.

executed by Hugh Cannon,[178] an artist bred and born in our own city, and a pupil of J. Struthers & Sons; and for faithfulness of resemblance and beauty of execution, is seldom excelled by any work of the kind, even from a foreign shore….

The monument itself, which is executed in a most masterly and perfect manner, from white American marble, emanates from the establishment of Messrs. Struthers & Son, and adds another to the very many specimens of excellent workmanship for which they are so celebrated…

On the front panel of the second plinth are the words:—"Erected by the City Councils of Philadelphia, June 1, 1848;" and on the reverse panel of the same the words—"To the memory of Frederick Graff, who designed and executed the Fairmount Water Works." The mound on which the monument stands is enclosed in a handsome iron railing.[179]

Foster and Taylor, ever clear-eyed, reflected upon the memorial:

…[L]et us pause a moment before this beautiful little Gothic monument in the center of the little grass plat vestibule. It has been but recently erected to the memory of FREDERICK GRAEFF [*sic*], the original planner, founder and architect of the Fairmount Water Works, a work of practical benevolence and wisdom which daily confers the inestimable blessing of an abundance of pure water upon two hundred and fifty thousand human beings, and cleanliness and security from fire to a beautiful and prosperous city. This monument, though somewhat tardy in making its appearance, is nevertheless an exceedingly chaste and appropriate testimonial of the gratitude of his fellow citizens to a great public benefactor.[180]

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[178] An identical bust by Cannon, apparently executed at the same time, resides in the Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University.

[179] "City Items, The Graff Monument," photocopy of clipping from unknown newspaper (1848). Historical Society of Philadelphia, research files of Jane Mork Gibson.

[180] George G. Foster, "Philadelphia in Slices, 6 Jan 1849," edited by George Rogers Taylor, *The Pennsylvania Magazine of History and Biography*, Vol. 93, No. 1 (Philadelphia: The Historical Society of Pennsylvania, Jan 1969), (1969), 65f.

Believed to be "earliest known memorial for an engineer in America,"[181] the Graff Memorial is still today preserved in its place of honor in the South Garden. Recently restored, it is a testament to Graff's contributions to the lives of the citizens of Philadelphia. His true monument, of course, is the Fairmount Water Works itself—its groundbreaking feat of civil engineering as well as its architectural design. This was recognized by the American Society of Civil Engineers in 1975 and the American Society of Mechanical Engineers in 1977 when each organization designated the Fairmount Water Works a National Historic Civil Engineering Landmark[182] and a National Historic Mechanical Engineering Landmark[183] respectively. Acknowledging its place in America's history, the federal government designated Fairmount a National Historic Landmark in 1976.[184]

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181 "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 4.

182 "Historic Landmarks, Philadelphia Municipal Water Supply," *American Society of Civil Engineers* (2019), <www.asce.org/project/philadelphia-municipal-water-supply>, accessed 27 Apr 2019. See also Jane Mork Gibson, "Fairmount Waterworks," *Bulletin,* Vol. 84, Nos. 360, 361 (Philadelphia: Philadelphia Museum of Art, Summer 1988), 39f.

183 "Fairmount Water Works, 1815–1911: A National Historic Mechanical Engineering Landmark," *American Society of Mechanical Engineers* (27 Mar 1977), <www.asme.org/about-asme/who-we-are/engineering-history/landmarks/21-fairmount-water-works>, accessed 27 Apr 2019. See also Jane Mork Gibson, "Fairmount Waterworks," *Bulletin,* Vol. 84, Nos. 360, 361 (Philadelphia: Philadelphia Museum of Art, Summer 1988), 39f.

184 "List of National Historic Landmarks by State," *National Historic Landmarks, National Park Service* (2019), <www.nps.gov/subjects/nationalhistoriclandmarks/list-of-nhls-by-state.htm>, accessed 27 Apr 2019. See also Jane Mork Gibson, "Fairmount Waterworks," *Bulletin,* Vol. 84, Nos. 360, 361 (Philadelphia: Philadelphia Museum of Art, Summer 1988), 40.

CHAPTER 6

EXPANSION AND CONSOLIDATION

Upon the death of Frederick Graff, his son Frederic Graff, Jr.,[1] was appointed Chief Engineer and Superintendent of the Fairmount Water Works eight days later, on 21 Apr 1847,[2] at the age of thirty. He had been working with his father for five years and filled his father's position at his father's salary. To say that the elder Graff left large shoes to fill would be a grotesque understatement, but Graff, Jr., was uniquely prepared for the position. His natural bent for engineering together with his having served under his father as Assistant Engineer for five years[3] made his selection by the Watering Committee an easy choice.

Graff, Jr., would not serve in his father's old position for as long as his father had—fifteen years over two periods versus his father's 42—but his leadership, like his father's, would be marked by creativity in response to the challenges of change. By all accounts he was a self-effacing man who found politics deeply frustrating. It seems, in fact, that one of the biggest reasons for his not serving at Fairmount longer than he did, despite his success, was his weariness over the political turmoil which surrounded every move, every decision, every proposal.

But successful he certainly was. His innovative approach laid the groundwork for the significant expansion and increased effectiveness of the Fairmount Water Works and the integration of the water distribution system with those in neighboring districts. Recognized as a leader in the field of hydraulic engineering, he was asked to consult on at least 37 other water

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[1] The younger Graff preferred to spell his given name without a K.
[2] "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519.
[3] "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519.

works projects,[4] including those in Cambridge, Massachusetts, Hartford, Connecticut, Providence, Rhode Island, and Brooklyn, New York. Between his two tenures as Chief Engineer of the Water Department, he pursued a private engineering practice with the I. P. Morris company. After leaving the Department for the second and final time, he worked from 1873 to 1877 with Henry R. Worthington, a manufacturer of steam engines in Brooklyn, New York.[5]

Although a man of science, Graff, Jr. also cultivated an appreciation for the fine arts, including music, painting, sculpture, and architecture. He was a thirty-year member of the board of directors of the Academy of Music; as chairman of the institution's building committee, Graff shepherded from 1855 to 1857 the design and construction of the Academy's renowned hall on South Broad Street, home of ballet and opera companies and, from 1900 to 2001, the Philadelphia Orchestra.[6] An accomplished amateur photographer, he helped found the Photographic Society of Philadelphia and served as its president for many years.

Throughout his life, Graff, Jr. contributed his time, talent for leadership, and scientific insight to numerous organizations. He was a member of the Academy of Natural Sciences, a member of the Union League, and an elected member of the American Philosophical Society. He served as a director of the Philadelphia Institute for the Deaf and Dumb, vice president of the Franklin Institute, president of the American Society of Civil Engineers,[7] and a founder and eventual president of the Zoölogical Society and Gardens.[8] A quiet philanthropist whose giving went largely unreported, he funded the construction of numerous churches in poorer

[4] "Frederic Graff, Jr.," *The Cultural Landscape Foundation* (2018), <https://tclf.org/pioneer/frederic-graff-jr>, accessed 5 Jun 2019.
[5] *Proceedings of the American Society of Civil Engineers,* Vol. XVII (Aug 1891), 248.
[6] As chairman of the building committee, Graff shepherded from 1855 to 1857 the design and construction of the Academy's renowned hall on South Broad Street, home of ballet and opera companies and, from 1900 to 2001, the Philadelphia Orchestra. See *History and Description of the Opera House or Academy of Music* (Philadelphia: 1857), 4ff.
[7] *Proceedings of the American Society of Civil Engineers,* Vol. XVII (Aug 1891), 247.
[8] This is still today the formal name of the Philadelphia Zoo.

neighborhoods of the city.

Late in life, Graff, Jr. married Elizabeth Mathieu, a lifelong friend of the daughters of Alfred V. du Pont, the son and successor of the founder of the du Pont company. When he died of heart disease in 1890 at the age of 73, he left no children.[9]

Graff, Jr. was someone who embraced change. He would need to because the need for change at Fairmount interposed itself whether sought for or not. The first challenge he faced upon becoming Chief Engineer at his father's death in 1847 was the increased demand for water.

When the water-powered system at Fairmount became operational in 1822, the population of the settled area of Philadelphia and the surrounding districts was approximately 110,000.[10] Thirty years later that number had grown to over 280,000.[11] Beyond simple numbers, the city was becoming increasingly industrialized. The full flowering of the industrial revolution was now being realized and that meant a great need for additional water.[12]

In addition to increases in population and industrial activity, a greater built environment meant more water was needed for firefighting. The threat of fire—as well as actual fires—kept water on the minds of the public. In 1838, for example, newly constructed Pennsylvania Hall, a speaker's venue built by a coalition of abolitionists, was burned to the ground by arsonists during a riot while an abolitionist convention was being held there. In 1842 anti-negro race riots along Lombard Street lasted for three days. From May to August of 1844, anti-Catholic riots by so-

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[9] "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 517ff; *National Cyclopædia of American Biography*, Vol. IX (New York: James T. White & Company, 1899, 1907), 514.

[10] U.S. Census Bureau, *Population of the 61 Urban Places: 1820*, <https://www.census.gov/population/www/documentation/twps0027/tab05.txt>, 15 Jun 1998, accessed 31 Jan 2019. Includes Spring Garden and Kensington neighborhoods.

[11] U.S. Census Bureau, *Population of the 61 Urban Places: 1850*, <https://www.census.gov/population/www/documentation/twps0027/tab08.txt>, 15 Jun 1998, accessed 7 Jun 2019. Includes Spring Garden and Kensington neighborhoods.

[12] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 241, 307ff.

called Nativists resulted in the destruction of two Catholic churches by arson and the threatening of many others.[13] In 1850 an accidental fire burned out of control and destroyed 367 buildings over eighteen acres, leaving 28 dead and 100 injured.[14] It didn't help that the fire companies often fought each other—at times murderously—rather than the fires for which they were ostensibly organized.[15]

Fortunately, the elder Graff had designed the system at Fairmount to be expandable as demand for water grew. When the first three breast wheels became operational in 1822, they had a total production capacity of approximately 4.25 million gallons per day. The average daily consumption in 1824 was 1.6 million gallons,[16] less than 38 percent of the system's capacity. The Fairmount Reservoir as it was constructed at the time had a capacity of a little over 7.2 million gallons[17] or approximately 4½ days' supply. In 1850 the full system of eight breast wheels and pumps had a total production capacity of approximately 10.5 million gallons per day, but only if all eight wheels were operating which was rare. Usually at least one wheel and pump set was stopped for maintenance or repair. The average daily consumption in 1852 was 5.7 million gallons,[18] or a little over half of the system's maximum capacity. More significantly, however, average daily consumption spiked during July to 7.3 million gallons per day,[19] approximately 70 percent of the system's capacity, again assuming full operation, or over 80 percent of capacity if only seven wheels were operating. The fully built-out Fairmount Reservoir

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[13] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 294ff, 353, 357f; Wolf, Edwin 2[nd], *Philadelphia: Portrait of an American City* (Philadelphia: Stackpole Books for The Library Company of Philadelphia, 1975), 170, 182, 198.
[14] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 241, 348.
[15] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 241, 346ff.
[16] Watering Committee, *1836 Annual Report* (5 Jan 1837), 19.
[17] *Sketch of the Water Works at Fairmount and Chestnut Street, Schuylkill* (Philadelphia: 1842), 25f.
[18] Watering Committee, *1852 Annual Report* (6 Jan 1853), 8.
[19] Watering Committee, *1852 Annual Report* (6 Jan 1853), 8.

by then had a capacity of a little over 22 million gallons or just over three days' supply.[20] This had become the normal state of affairs and it was growing worse. There was little margin of safety in case of equipment breakdown or problems with any of the reservoir's basins.

In 1851 Graff, Jr. had reported that the Fairmount Water Works could barely keep up with demand.[21] In fact, when the residents of the municipality of West Philadelphia that year requested to be supplied with water from the Fairmount system, Graff, Jr. strongly opposed it.[22] Two years later, West Philadelphia would begin construction of its own water works and distribution system. Even in 1844, recall, the Spring Garden District, unwilling to rely on Fairmount (and, not incidentally, unwilling to pay half again more for its water than Philadelphia itself), had completed its own system.

Fairmount at one time could produce a supply of water far in excess of demand, but no longer. Demand had caught up with supply. With the Fairmount Water Works being the only source of water for the entire City of Philadelphia and neighboring districts like Southwark and Moyamensing, Graff, Jr. faced the enormous challenge of finding a way to increase the supply of water. With the system unable to expand further, it was obvious that something had to change.

There were three constraints to the current system of breast wheels and pumps. The first was that the Mill House had been operating with its full complement of eight breast wheels since 1843. There was no room for additional wheels.

The second constraint was the tidal nature of the Schuylkill River at Fairmount. Recall that as the water level rose toward 16 inches above the bottom of the breast wheels, the wheels

[20] Watering Committee, *1849 Annual Report* (3 Jan 1850), 6.
[21] Frederic Graff, Jr., *Report to the Watering Committee of the City Councils* (Philadelphia: 20 Feb 1851), 2; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 99, 303n.101.
[22] *Journal of the Select Council, 1851–1852*, Appendix, 4f; cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 99, 303n.102.

slowed and then stopped. As the tide receded, the wheels started again and slowly sped back up. For each cycle of the tide, the wheels were completely stopped for approximately an hour and slowed for approximately 1½ hours on either side of the stoppage. With an average of two tidal cycles per day, the wheels were stopped for two hours daily and slowed for six.

The third constraint was the Schuylkill River's tendency to flood during and after severe rainstorms. These so-called freshets were unpredictable and often rose as high as the top of the wheels. If the wheels were stopped when the tide rose to 16 inches above their bottom, they certainly were not able to do any work when the water rose to their tops.[23] A freshet could stop the wheels for an entire day or two, forcing a drawdown of the water in Fairmount Reservoir and threatening the water supply for the city.

There was a relatively new technology, however, which offered a possible solution to some or all of these problems: the turbine.

In 1843, recall, the Graffs had in fact investigated the newly developed turbine when Wheel No. 1 needed to be replaced. Their idea was to install one in place of the breast wheel and evaluate the device for possible replacement of each of the other wheels as they reached the end of their respective useful service lives. After initially agreeing with the recommendation, the Watering Committee had reversed itself and decided not to install a turbine but to instead replace the first breast wheel in kind. At the time, the elder Graff had expressed his disappointment and frustration with being forced to pass up the opportunity to work with the new technology.[24] Now eight years later, Graff, Jr. wanted the Watering Committee to take another look.

Although the crude Norse wheel or tub wheel had been in use for many years, the turbine

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[23] Watering Committee, *1822 Annual Report* (Philadelphia: 4 Jan 1844), 7; Watering Committee, *1845 Annual Report* (8 Jan 1846), 12. The Annual Report indicates an average stoppage of approximately 64 hours per month.
[24] Frederick Graff to Alfred V. du Pont, Esq., 27 May 1845. Hagley Museum.

as it was now developed was more efficient than earlier designs and was able to operate under a wide variety of conditions. It consisted of a stationary horizontal wheel with curved vanes that directed the downward flow of water to a rotating wheel which also had curved vanes. The rotating wheel was connected to a central drive shaft which transmitted the motion of the rotating wheel, generating power.[25]

While the water wheel operates by the weight or impact (or both) of water (with the breast wheel operating on virtually weight alone), the turbine operates on pressure and reaction. Because water acts on all of the turbine's curved blades at the same time, it generates more power and is more efficient than the water wheel in which the water acts on only a few of the buckets at a time. The manner in which water is discharged from the turbine is also as important as the manner in which it is directed into it. As with the breast wheel, the water ideally should enter without splashing and exit without turbulence, following the principle established by Jean-Charles de Borda for the breast wheel in 1767 (and later made explicit by Lazare Carnot): *L'eau devait entrer sans choc et sortir sans vitesse.* (The water must enter without impact and leave without velocity). To achieve this goal, turbines were often mathematically designed for a specific location, especially in Europe and early on in America. Later, especially in America, turbine developers had great success with mass-produced stock designs which could be ordered from catalogues for even the smallest of applications.

The word *turbine*,[26] derived from the Latin *turbo* and *turbin-*, meaning a vortex or

[25] These same components are still found in modern turbines today, though the medium may be water, steam, a combination of air and jet fuel, or a combination of liquid oxygen and rocket fuel.
[26] Overview of the development of the turbine adapted from Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore: The Johns Hopkins University Press, 1983), 233ff, 241; Melvin Kranzberg and Carroll W. Pursell, Jr., eds., *Technology in Western Civilization, Vol. I: The Emergence of Modern Industrial Society, Earliest Times to 1900* (New York, Oxford University Press, 1967) 337f; Louis C. Hunter, *Steam Power: A History of Industrial Power in the United States, 1780–1930,* Vol. II (The University Press of Virginia for the Eleutherian Mills-Hagley Foundation, 1985), 293; Edward W. Constant, "Scientific Theory and

whirlpool, was coined in 1822 by the French physicist Claude Burdin[27] (1788–1873) who developed early theoretical principles. Benoît Fourneyron[28] (1802–1867), a student of Burdin's at the École Nationale Supérieure des Mines, a technical school in Saint-Étienne, applied his teacher's theories to create the first successful turbine in 1824. By 1837 Fourneyron had developed a more effective design which was small (one foot in diameter) yet powerful (60 horsepower/45 kilowatt) and efficient (80 percent). Spinning at an unheard-of 2,300 rpm, Fourneyron's turbine featured an outward-flow design in which the water exited laterally, perpendicular to the axis of the machine. In 1840 Feu Jonval[29] developed an axial-flow turbine in which the water exited down and parallel to the axis. Because Jonval's turbines were built by locomotive manufacturer André Koechlin[30] (1789–1875)[31] they were sometimes known as both "Jonval turbines" or "Koechlin turbines."

Four individuals were instrumental in introducing the new French technology to Americans. Uriah Boyden and James B. Francis promoted and further developed the Fourneyron turbine in New England. In the mid-Atlantic states, Elwood Morris promoted a modified Fourneyron turbine and Emile Geyelin promoted and improved the Jonval turbine on behalf of Jonval and Koechlin.

Active in the Franklin Institute, Morris translated into English the published results of

Technological Testability: Science, Dynamometers, and Water Turbines in the 19th Century," *Technology and Culture,* Vol. 24, No. 2 (Apr 1983), 183ff; Abbott Payson Usher, *A History of Mechanical Inventions,* revised ed. (New York: Dover Publications, 1982), 382ff; William Fairbairn, *Treatise on Mills and Millwork, Part I: On the Principles of Mechanism and on Prime Movers,* third ed. (London: Longmans, Green, and Co., 1871), 157ff; Edward T. Layton, Jr., "Scientific Technology, 1845–1900: The Hydraulic Turbine and the Origins of American Industrial Research," *Technology and Culture,* Vol. 20, No. 1 (Jan 1979), 64ff.

[27] Pronounced approximately "CLODE ber-DA^{N}" with the final syllable ending in an open nasality.

[28] Pronounced approximately "ben-WAH FOR-nee-ro^{n}" with the final syllable ending in an open nasality.

[29] Pronounced approximately "FEH zho^{n}-VAHL" with the first syllable of the last name ending in an open nasality.

[30] Pronounced approximately "AHN-dray kake-LA^{N}" with the final syllable ending in an open nasality.

[31] Michael Stephen Smith, *The Emergence of Modern Business Enterprise in France, 1800–1930* (Harvard University Press, 2006), 209.

French tests of Fourneyron's turbines and re-published them in the organization's *Journal* in 1842 and 1843.[32] Comparing them with the results of the Institute's water wheel tests, he showed that turbines were more efficient. Morris developed a modified version of Fourneyron's design, contracted with Samuel V. Merrick to construct it at the Merrick & Towne foundry, and reported on its actual use on the Brandywine Creek in nearby Delaware.

Born in Mulhouse in the Alsace region of France, and descended from Huguenots,[33] Emile Camille Geyelin[34] (15 Nov 1825–25 Jun 1900) completed his schooling at the prestigious École Centrale des Arts et Manufactures in Paris[35] and went on to study and apply hydraulic and mechanical engineering under Feu Jonval. After working with Koechlin & Co, he emigrated to the United States in 1848,[36] at the age of 23, with the franchise[37] for the sale of Jonval turbines in America. Settling in Philadelphia,[38] Geyelin quickly became a recognized authority in the

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[32] Elwood Morris, "Remarks on Reaction Water Wheels Used in the United States and on the Turbine of M. Fourneyron," *Journal of the Franklin Institute,* Vol. 34 (Oct 1842), 217ff, (Nov 1842), 289ff; Elwood Morris, "On the Frictional Dynamometer, or Brake, of M. de Prony, a Cheap, Simple, and Effective Instrument, for Measuring the Actual Power Developed by Machines," *Journal of the Franklin Institute,* Vol. 35 (1843), 225ff; Elwood Morris, "Experiments on the Useful Effect of Turbines in the United States," *Journal of the Franklin Institute,* Vol. 36 (Nov 1843), 377ff; and Elwood Morris, trans., "Experiments on Water-Wheels, having a vertical axis, called Turbines, by Arthur Morin, Captain of Artillery, Professor of Machinery in the School of Artillery, etc., etc.," Vol. 36 (Oct 1843), 234ff, (Nov 1843), 289ff, and (Dec 1843), 370ff. Quoted and cited variously in Edward T. Layton, Jr., "Scientific Technology, 1845–1900: The Hydraulic Turbine and the Origins of American Industrial Research," *Technology and Culture,* Vol. 20, No. 1 (Jan 1979), 70n.21; Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute 1824–1865* (Baltimore and London: The Johns Hopkins University Press, 1974), 322f, 322n.40; Edward W. Constant, "Scientific Theory and Technological Testability: Science, Dynamometers, and Water Turbines in the 19th Century," *Technology and Culture,* Vol. 24, No. 2 (Apr 1983), 188f, 189n.25, 190f, 191n.31.

[33] "Death of Emile C. Geyelin," *St. Louis Globe-Democrat* (26 Jun 1900), 2. The Huguenots were French Protestants.

[34] Pronounced "eh-MEEL kuh-MEEL zhay-LA^{N}" with the final syllable ending in an open nasality.

[35] "Death of Emile C. Geyelin," *Philadelphia Inquirer* (27 Jun 1900), 10; "Death of Emile C. Geyelin," *St. Louis Globe-Democrat* (26 Jun 1900), 2.

[36] *New York Passenger Lists, 1820–1957* (Microfilm roll M237-76, Line 12, List 1301). Geyelin travelled alone on the S.S. Waterloo from Great Britain to New York, arriving 18 Nov 1848.

[37] Watering Committee, *1851 Annual Report* (1 Jan 1852), 9; Watering Committee, *1852 Annual Report* (6 Jan 1853), 37.

[38] Geyelin appears to have first lived in a boarding house in what is now Center City Philadelphia. When he married Marie Francesca Estella Antoinette (de) Laussat (at St. Stephen's Episcopal Church at 19 South 10th Street) in 1854, the couple moved into a home at 317 South 13th Street. Within a few years of the birth of their son Henry Laussat Geyelin in 1857, the family moved to a home at 1430 Spruce Street. By 1868, the Geyelins had moved to a home at 4227 Chestnut Street in West Philadelphia, where Emile and Estella would live for the remainder of their lives. The

custom design and installation of Jonval turbines. After the mid-1870s he designed and installed hydraulic power plants as a consulting engineer for R. D. Wood & Co. of Philadelphia. In addition to his work at the Fairmount Water Works he designed and installed turbines in numerous locations, including August, Maine; Watertown, New York; Willimantic, Connecticut; Richmond, Virginia; Manchester, New Hampshire; and Montreal, Canada. During his lifetime he was perhaps most well known for his innovative and enormous installation at Niagara, New York.[39]

Geyelin made his first contacts in the United States by writing in French to E. I. du Pont de Nemours & Company, the gunpowder manufacturing company in Delaware.[40] The du Ponts originated in France and family members still spoke in both English and French at home. By

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Geyelins rented the house from one of Estella's uncles. The family resided in the house with four servants and five of Estella's relatives (including Geyelin's mother-in-law until her death in 1872) who lived there as boarders. The home was described by Henry as modest and old-fashioned in its appointments. The Geyelins attended St. Mary's Episcopal Church a few blocks from their home, where Emile was eventually elected to the vestry. Judging from some of Henry's letters to his fiancée, Emile Geyelin travelled a great deal when his son was young, but the two seem to have reconnected when Henry was in his twenties and they enjoyed spending time together. See 1850 U.S. Federal Census, Philadelphia South Ward, Roll M432-812, p.115B; 1870 U.S. Federal Census, Philadelphia Ward 27, District 6, 2nd Enumeration, Roll M593-1443, p. 92, Image 185; 1880 U.S. Federal Census, Philadelphia, Roll T9-1186, Family History Film 1255186, p. 86.2000, Enumeration District 573, Image 0175; 1890 U.S. Federal Census, Philadelphia Ward 27; ; U.S. Internal Revenue Service Tax Assessment Lists, 1862–1918; Pennsylvania Church and Town Records, 1708–1985 "Vestry Elections," *Philadelphia Inquirer* (19 Apr 1876), 2; U.S. Passport Applications, 1795–1925, National Archives and Records Administration; Henry Laussat Geyelin to Alice Reed Rawle, 15 Aug 1882; Henry Laussat Geyelin to Alice Reed Rawle, 26 Aug 1882; Henry Laussat Geyelin to Alice Reed Rawle, 24 Sep 1882; Henry Laussat Geyelin to Alice Reed Rawle, 8 Oct 1882.

[39] John C. Trautwine, Jr., et al., "Obituary: Emile C. Geyelin," *Proceedings of the Engineers' Club of Philadelphia,* Vol. XVIII, No. 1 (Feb 1901), 68f; William B. Bull, "Our Portraits: Emile Geyelin," *Fire Engineering* (4 Nov 1891), <www.fireengineering.com/articles/print/volume-1891-9/issue-15/features/our-portraits.html>, accessed 9 Jun 2019; "The Late Emile C. Geyelin," *Fire Engineering* (14 Jul 1900), <www.fireengineering.com/articles/print/volume-28/issue-2/features/the-late-emile-c-geyelin.html> accessed 9 Jun 2019; "Emile Camille Geyelin," *Geni* (last updated 1 Nov 2014), <www.geni.com/people/Emile-Geyelin/6000000029263838944>, accessed 8 Jun 2019; "Marie Francesca Estella Antoinette Geyelin (Laussat)," *Geni* (last updated 1 Nov 2014), <www.geni.com/people/Marie-Geyelin/6000000029263770973?through=6000000029263838944>, accessed 8 Jun 2019; "Emile Camille Geyelin," *Find A Grave*™ (8 Jul 2010), <www.findagrave.com/memorial/54661340/emile-camille-geyelin>, accessed 8 Jun 2019.

[40] See Geyelin to E. I..Dupont [*sic*] de Nemours, 16 Mar 1850, 29 Mar 1850, Collection of the Hagley Museum, for extant examples. This was also the beginning of a close relationship between the du Pont and Geyelin families which lasted for generations. See Allan J. Henry, ed., *The Life of Alexis Irénée du Pont* (Philadelphia: Wm. F. Fell Co., 1845), 205.

1850 the du Ponts had installed one of Geyelin's Jonval turbines, constructed by the Isaac P. Morris iron works of Philadelphia, at their works on the Brandywine Creek. A report of trials showing that it operated at 75 percent efficiency was published by the Franklin Institute.[41]

One design element added to the Jonval turbine made it particularly attractive—the Parker Draft Tube.[42] Invented and patented in 1840 by brothers Zebulon and Austin Parker, two millwrights from Zanesville, Ohio, the device was essentially a cylindrical, watertight shroud beneath the turbine proper. When installed on a Jonval turbine,[43] the modification allowed water that had passed through and powered the turbine to be discharged below the water level of the tailrace. The weight of the falling water created a suction force; this siphon effect pulled the water out of the bottom of the turbine, increasing its efficiency and, just as important, allowing it to operate at all times. A Jonval turbine could thus operate during high tides and even when completely submerged during flood events; it would not be immobilized like the breast wheels.

Graff, Jr. had been quietly collecting data on turbines for some time.[44] He had been giving serious consideration to the question of replacing the breast wheels with turbines but had decided, even as early as 1848, that the demand for water was so great that he could not afford to take any of the breast wheels out of service for the length of time which would be required to make the substantial modifications to a portion of the Mill House and install the newer technology. He also made the determination that the blasting and excavation necessary for the

[41] *Journal of the Franklin Institute,* Vol. XX, No. 3 (1850).
[42] Edward T. Layton, Jr., "Scientific Technology, 1845–1900: The Hydraulic Turbine and the Origins of American Industrial Research," *Technology and Culture,* Vol. 20, No. 1 (Jan 1979), 69.
[43] Recall that water was discharged axially downward in the Jonval turbine while it was discharged laterally in the Fourneyron turbine.
[44] Design drawing by Frederic Graff, Jr., "Economical Efficiency of the Wheels at Fairmount Water Works, Calculated from Data Furnished to F. Graff by Z. Parker" (20 Nov 1848), Philadelphia Museum of Art; "Estimate of the Effect of Parker's Wheel for Raising Water at Fair Mount," submitted by Zebulon Parker, Philadelphia Museum of Art. Cited in Historical American Engineering Record. *Fairmount Water Works 1812–1911* (Washington, D.C.: U.S. Department of the Interior, 1978), 89n.22.

alterations would put the operating breast wheels at risk.[45]

During the summer of 1850, however, two events occurred which brought a sense of urgency to the turbine question. During a freshet which began on 19 July, the Schuylkill River rose to eight feet abovr the top of the Fairmount Dam and five feet, five inches above the floor of the Mill House. The breast wheels, submerged above their axles, were completely stopped for two days and seven hours. The Fairmount Reservoir came within 21 hours of being emptied. "The consequences of such a casualty can scarcely be imagined, and it certainly behooves Councils by every possible means to guard against even the probability of such an event,"[46] warned Graff, Jr. in a special report to the Watering Committee.[47] When the water had receded enough for the wheels to begin turning again, it took an entire week for all eight wheels, operating at their maximum, to refill the reservoir.[48] Graff, Jr. further remarked, "For the first four days of that time all that was gained upon them during the night, was lost before ten o'clock the next day; and had an extraordinarily large fire taken place in the City or Southern Districts during that time, there would have been a very great danger of a total loss of the supply of water to the city."[49] A similar flood event in September halted pumping for 45 hours, after which the reservoir took four and a half days to refill.

Although Graff, Jr. primarily used the events to illustrate the need for additional reservoirs, he also made the point that "the means of increasing our power at Fair Mount must be speedily provided."[50]

Graff determined that a turbine needed to be installed—a Jonval turbine with a Parker

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[45] See also Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 89f.
[46] Frederic Graff, Jr., *Report to the Watering Committee of the City Councils* (4 Dec 1850), 4.
[47] Frederic Graff, Jr., *Report to the Watering Committee of the City Councils* (4 Dec 1850).
[48] The remaining high water, in combination with the tides, stopped the wheels for longer than the usual one hour twice per day and slowed the wheels for longer than the usual three hours twice per day.
[49] Frederic Graff, Jr., *Report to the Watering Committee of the City Councils* (4 Dec 1850), 4.
[50] Frederic Graff, Jr., *Report to the Watering Committee of the City Councils* (4 Dec 1850), 5.

Draft Tube. Once in place it would be evaluated as a candidate for eventual replacement of the breast wheels.[51]

The next question that needed to be answered was one of placement. Where could a turbine be installed? Graff, Jr. had already ruled out replacing an existing breast wheel or, indeed, any installation regarding the Mill House. The Engine House was unworkable. Because of the necessity of substantially altering the foundation walls and extending the Forebay—with undesirable blasting—installing one there would likely have resulted in its demolition. There seemed to be only one viable option—the open space between the Engine House and the Mill House.

Graff, Jr. created an operating area for the turbine by constructing a new river wall in front of the Engine House's existing 1814 river wall and enclosing the portion of the Esplanade that ran there. He then roofed over the entire space, including the wedge-shaped area between the Engine House and the Mill House. The covering above was not a level deck but a timbered roof which sloped gently toward the river. The new space was shaped like a reverse L, with the shorter portion between the two buildings and the longer portion along the river. The turbine and its gearing would be placed in the space between the two buildings and the pump would be placed in the new room in front of the Engine House.

The Forebay's waste gate, designed to allow the temporary emptying of the Forebay for maintenance or repair, had originally passed through the gap between the two buildings. Graff, Jr. repurposed it into a flume for the turbine and branched off two supply flumes for the pump. He connected the pump's discharge main to the old, original 16-inch ascending main, abandoned in place in 1832, through which the two steam engines had raised water to the Fairmount

[51] Watering Committee, *1867 Annual Report* (20 Feb 1868), 6. For this reason this first turbine, installed in 1851, is often today called the "Test Turbine."

Reservoir from 1815 until they were shut down in 1822.

Graff, Jr. ordered the Jonval turbine from Emile Geyelin[52] in May 1851 and the I. P. Morris & Co. foundry was contracted to fabricate and install it.[53] Because of the extremely tight squeeze—a slot had to be cut into the south wall of the Mill House in order to fit the flywheel and the wheel actually dipped approximately one foot into the water in the tail race during high tide—installation took longer than expected. Graff, Jr. projected the installation would be finished by August[54] but the turbine didn't become fully operational until 16 Dec.[55] One can almost hear Graff, Jr.'s frustration in Watering Committee Chairman John Price Wetherill's annual report:

> The completion of the Turbine wheel and pump was retarded considerably beyond the period expected, principally on account of the confined situation which the wheel occupies, making it difficult and tedious to get such large castings as were required for the work into their proper situations. [56]

Geyelin was paid a total of $8,490[57] in three installments—two each of $2,827 on 18 Jun 1851[58] and 5 Nov 1851,[59] and one of $2,836 on 3 Mar 1852.[60] The same date as Geyelin's last payment, I. P. Morris & Co. was paid $312[61] for floor girders, a fly wheel case, and miscellaneous fittings associated with the turbine's installation.[62]

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52 Watering Committee, *1851 Annual Report* (1 Jan 1852), 9.
53 Watering Committee, *1851 Annual Report* (1 Jan 1852), 9.
54 Emile Geyelin, *Description of Jonval's Turbine,* Plate VI, "Jonval's Turbine as received by the Watering Committee of Fairmount Water Works" (1851). Parenthetical note beneath full title at lower left: "To be in operation in August 1851."
55 Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 48 ("Date of important events…").
56 Watering Committee, *1851 Annual Report* (1 Jan 1852), 7.
57 The equivalent of approximately $326,600 in 2022.
58 Watering Committee, *1851 Annual Report* (1 Jan 1852), 30.
59 Watering Committee, *1851 Annual Report* (1 Jan 1852), 31.
60 Watering Committee, *1852 Annual Report* (6 Jan 1853), 64.
61 The equivalent of approximately $12,000 in 2022.
62 Watering Committee, *1852 Annual Report* (6 Jan 1853), 64.

The heart of Geyelin's Jonval turbine[63] consisted of two stacked wheels—a stationary one on top and a moveable one beneath—within a watertight casing or nacelle. Each of the wheels consisted of a cast-iron rim into which curved wrought-iron vanes or blades were mortised.

The stationary wheel was eighteen inches deep and slightly conical, eight feet in diameter at its top and seven feet in diameter at its bottom. It had twelve vanes curved in a spiral pattern. Each vane was twenty inches long along its top edge and thirteen inches long along its bottom edge. The cylindrical moveable wheel, located just below the stationary wheel, was ten inches deep and seven feet in diameter. It had thirty spiral vanes each slightly over thirteen inches long and was attached to the main upright shaft.

A cast-iron cylindrical casing ten feet in diameter and five feet deep was attached above the stationary wheel; this upper casing served as a reservoir to receive water through its side into the turbine. A round cover was bolted to the top edge of the upper casing. The main shaft projected vertically up through the center of the cover and was connected to a set of external gears.

The top of the casing and the top of the flume were at the level of the top of Fairmount Dam. Water from the flume entered the turbine from above, through the side of the upper casing. As the water fell down through the upper wheel, the wheel's stationary guide vanes directed the water in a clockwise direction (when viewed from above) against the vanes of the lower, moveable wheel. Since the vanes of the moveable wheel were angled in an opposite direction from the guide vanes of the stationary wheel, it turned in a clockwise direction (when viewed from above) in reaction to the water falling through it. After passing through the lower, rotating

[63] Watering Committee, *1854 Annual Report* (19 Apr 1855), 6f; Water Department, *Chief Engineer's 1859 Annual Report*, 9 Feb 1860, p. 24.

wheel the water passed through a cylindrical lower casing and discharged below the surface of the water in the tail race.

The rotating wheel turned the main shaft of the turbine, which in turn drove a pair of external bevel gears at the top which changed the axis of the rotational motion ninety degrees from vertical to horizontal. The horizontal rotating shaft drove a pair of reduction gears (one smaller, one larger) which drove a flywheel and a crank wheel. The reduction gears reduced the rotation speed without decreasing the power output. The flywheel provided momentum which stabilized the rotation speed. The crank wheel was attached to a drive shaft which converted the rotational motion to reciprocal (back-and-forth) motion and drove a double-acting pump which pushed water taken from the flume up to the reservoir through the discharge main and ascending main. The pump was similar to those of the breast wheels—sixteen inches in diameter, with a double-acting six-foot stroke. It operated at 12 strokes per minute. Like the other pumps, it included an air vessel which reduced pressure spikes and lessened so-called "water hammer."

Two features of Geyelin's design of the Jonval turbine proved their worth. The first was the incorporation of the Parker Draft Tube. The entire casing, from top to bottom, was watertight. Except for a small cushion of air at the top of the slightly domed cover, water completely filled the flume, the reservoir above the wheels, the wheels themselves, and the lower casing. As the water fell below the lower, rotating wheel, it passed through a cylindrical, watertight, cast-iron skirt. The diameter of this lower casing was slightly greater than the diameter of the lower wheel and the outlet was situated below the level of the water in the tailrace so that air could not enter from below. The volume of water issuing from the rotating wheel above was less than the volume of the space within the lower casing. This created a downward suction force. This siphon effect "pulled" the water down and increased its velocity as

it passed through the rotating wheel, increasing the rotational speed of the wheel. This increased the turbine's efficiency and the power it produced.[64] It also allowed the turbine to operate during periods of high tide, indeed no matter how high the water level rose.[65]

Second, although the stationary wheel did not rotate, it was not attached to the casing and was able to move vertically. Since it fit within the slightly conical section above the moveable wheel and was held down only by its own weight and the pressure of the water passing through it, the stationary wheel tended to be lifted by any debris carried by the water and was therefore less liable to be broken by stones or heavy sticks. This also made the turbine much easier to repair without taking the whole thing apart. Even the lower wheel could be accessed by unbolting the cover and lifting the stationary wheel. This was a significant advantage over other designs.[66]

The turbine's performance was impressive from the start. With a capacity of 87,408 gallons per hour, the turbine's output was nearly ten percent higher than the best breast wheel in the Mill House.[67] Within a year, it had also already proven its ability to run while the breast wheels were out of commission during a freshet.[68] Watering Committee Chairman Wetherill reported:

> The performance of the wheel has exceeded the most sanguine [optimistic] expectations. By this wheel we shall be able to gain some six hours per day in time, and about 512,183 ale gallons in quantity, over any heretofore used. The success of this wheel cannot but be considered as very important, inasmuch as similar ones would give the power to increase the

[64] Henry P. M. Birkinbine, *Report on the Experiments with Turbine Wheels* (1861), 13.
[65] Watering Committee, *1854 Annual Report* (19 Apr 1855), 7; Watering Committee, *1856 Annual Report* (22 Jan 1857), 4.
[66] Henry P. M. Birkinbine, *Report on the Experiments with Turbine Wheels* (1861), 13.
[67] Water Department, *Chief Engineer's 1859 Annual Report,* 9 Feb 1860, p. 24.
[68] Watering Committee, *1852 Annual Report* (6 Jan 1853), 8.

> efficiency of our works hereafter…[69]

As to what this meant for the future, Wetherill continued:

> …by adopting such wheels to the present pumps in place of those now employed, a power to raise at least 4,166,281 gallons more than we are now able to do, could be obtained and by substituting stronger pumps than those now in use, it is quite probable and addition of 6,000,000 gallons per day could be obtained. [70]

The Jonval turbine was a great success and pointed the way forward.[71]

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When we look at Graff, Jr.'s dire plea for increased pumping and storage capacity in his annual report for 1850, we today tend to focus on the resulting introduction of the turbine. This is most likely due to the obvious ways that it recognizably changed the water works over the next fifteen years. Less dramatic but no less important, however, was the Watering Committee's acceptance of the need for increased reservoir space. The need was so manifest, in fact, that by the time the 1850 annual report was published in January of 1851 the Watering Committee had already purchased ground to build a new reservoir.[72]

Because there was no room left atop the summit of Fairmount, however, an additional reservoir had to go elsewhere. The Watering Committee acquired land for a new reservoir in the

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[69] Watering Committee, *1851 Annual Report* (1 Jan 1852), 7f.
[70] Watering Committee, *1851 Annual Report* (1 Jan 1852), 7.
[71] For Graff, Jr. the positive aspects were not only in the professional sphere. He and Geyelin appear to have established a long-term friendship. In fact, it was through Geyelin that Graff, Jr. met and married Elizabeth Mathieu, a friend of Alfred V. du Pont's daughters. The influence of the du Ponts' French culture may explain Graff's dropping the K at the end of his first name by early 1854. It may perhaps be seen as a preference for the French "Frederic" over the German-English "Frederick."
[72] Watering Committee, *1852 Annual Report* (6 Jan 1853), 37ff.

Spring Garden District northeast of Fairmount, a little less than half a mile away as the crow flies. It was bounded by Corinthian Avenue on the east, Schuylkill Front Street (today's North 22nd Street) on the west, Parrish Street to the South, and Poplar Street to the north. The new facility constructed there was called the Corinthian Avenue Reservoir.[73] It consisted of an embankment measuring 721 feet by 400 feet around the exterior perimeter and had a capacity of a little over 16.6 million ale gallons.[74] Taking a leaf out of his father's book, Graff, Jr. designed the embankment with a profile that allowed it to be easily raised, thereby increasing the reservoir's capacity, if more powerful machinery were installed at Fairmount at some future time. All of the material used for the embankment was excavated from the interior of the property. Construction began on 21 Apr 1851 and was completed on 25 Sep. After this was finished, it was allowed to stand over the winter in order to allow the fill to settle. Beginning 14 May of the following year, it was lined with tamped clay, lime and red gravel mortar, and grouted bricks. Water began being pumped into it on 22 Dec 1852.

The level of the water in the Corinthian Avenue reservoir was sixteen feet higher than the level of the water in the Fairmount Reservoir.[75] In order to fill the new facility effectively, Graff, Jr. erected a standpipe in 1852 just below the crest of the Fairmount Reservoir, above the Forebay.

Acting as a type of water tower, the functional component of the Standpipe[76] was a

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[73] Watering Committee, *1851 Annual Report* (1 Jan 1852), 6f; Watering Committee, *1852 Annual Report* (6 Jan 1853), 5ff, 37ff, and table at 48 ("Date of important events…").
[74] Watering Committee, *1852 Annual Report* (6 Jan 1853), 7, 38. The two sources contradict one another, albeit trivially. In the latter, Graff, Jr. reports 6,646,247 ale gallons in his Superintendent's report. In the former, Wetherill reports 16,655,867 ale gallons in his overall annual report to the Watering Committee. The reason for the discrepancy is not known.
[75] Watering Committee, *1852 Annual Report* (6 Jan 1853), 38; Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 9.
[76] Watering Committee, *1852 Annual Report* (6 Jan 1853), 7, 39, 59; Frederick Graff, Jr., *Notebooks*, c.1872. Philadelphia Water Department Historic Archives, Accession 2004.062.003.

vertical cast iron tube, fifty feet tall and four feet in diameter. Composed of cylindrical iron segments, the top was thirty feet above the level of Fairmount Reservoir and fourteen feet above the Corinthian Avenue Reservoir. Water pumped up into it became a water column, the weight of which—a little over 19½ tons[77]—counteracted the weight of the effective 16-foot-high "column of water" inside the main leading to the Corinthian Avenue Reservoir. This helped "push" water through the main to the Corinthian Avenue Reservoir and reduced strain on the pumps in the Mill House from the backpressure of the weight of the water within the main.[78]

The ascending mains were connected to the base of the vertical iron pipe on its south side (the right side as viewed from the Mill House) by a horizontal taper pipe which narrowed from four feet in diameter at the Standpipe's base to twenty inches in diameter at its farthest end. The ascending mains connected to the taper pipe in such a way that water from each of the pumps could be selectively thrown to either the Fairmount or Corinthian Avenue Reservoirs, as the situation required. The total dry weight of the Standpipe and the lateral connecting pipe was a little under 24½ tons. From the opposite side of the base of the Standpipe (the north side, or left side as viewed from the Mill House) a thirty-inch main carried water 3,747 feet (approximately seven tenths of a mile) to the Corinthian Avenue Reservoir.

What the public perceived as the Standpipe was in fact the decorative masonry surround, within which the great iron tube was concealed. The brick exterior was designed to protect the iron pipe and the water inside it from the elements, especially freezing temperatures, and present an aesthetically attractive appearance. Designed by Graff, Jr. in the Italianate style, it emulated a

[77] The weight of the water within the Standpipe may be determined by multiplying the volume of the water contained within (as measured in cubic feet) by the weight of a cubic foot of water. Using the formula for the volume of a cylinder ($V = \pi r^2 h$), the volume is determined to be 628.32 cubic feet. Assuming the weight of one cubic foot of water to be the standard 62.3 pounds (at 70°F), the total weight of the water is calculated to be 39,144.33 pounds or 19.57 tons. The water pressure at the base of the Standpipe (at the bottom of the 50-foot-tall column of water) would have been 21.68 psi (pounds per square inch).
[78] Watering Committee, *1852 Annual Report* (6 Jan 1853), 7.

Venetian campanile.

I. P. Morris & Co. was paid $1,534[79] on 7 Jul 1852 for the fabrication of the Standpipe's iron work.[80] A month earlier Jacob Stiles had been paid $47[81] to eventually haul all of the iron castings to Fairmount.

The combination of the turbine and the additional water storage capacity meant that the basins of the Fairmount Reservoir could be cleaned out for the first time since their construction. Cleaning a basin necessitated taking it out of action and draining it. Up to now this had been too risky, but with added capacity came a little breathing space.

The cleaning of the basins, one at a time, began on 27 Mar 1851 and continued until sometime in the summer when the demand for water required the use of all of the storage space atop Fairmount. By that time Basins 1, 3, and 4 were completed. Frederick Graff's prudence in designing separate cells had been demonstrated anew. Nevertheless, the cleaning of Basin 2 had to be delayed until December of 1852 when the Corinthian Avenue Reservoir was filled. Prior to the completion of the Standpipe and new reservoir, all of the ascending mains from the Mill House discharged directly into Basin 2. Taking it offline and draining it would have meant shutting down all of the pumping activity at Fairmount save for the turbine, whose main discharged into Basin 1. This was determined to be a situation too precarious to sustain for longer than two days at a time. After the Standpipe and Corinthian Avenue Reservoir were completed, though, the new facility could be used as a backup and Basin 2 could finally get the scrubbing it needed.[82]

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[79] The equivalent of approximately $59,000 in 2022.
[80] Watering Committee, *1852 Annual Report* (6 Jan 1853), 65.
[81] The equivalent of approximately $1,800 in 2022.
[82] Watering Committee, *1851 Annual Report* (1 Jan 1852), 5f.; Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 48 ("Date of important events…").

By the time the reservoir was cleaned, the oldest basin, No. 1, had been in operation for 31 years. The settled-out muck ranged from four inches thick in Basin No. 4 to "considerably greater" than ten inches in Basin No. 2 where the deep deposit resulted from its receiving water directly from the ascending mains and acting as the primary settling or "sedimentation" basin.

In May 1852 it was determined that the average consumption of water was 3,392,552 ale gallons during the day between six o'clock in the morning and six in the evening and 1,272,268 ale gallons overnight between six in the evening and six in the morning. In the summer of that year, the greatest consumption of water was found to take place between the hours of nine o'clock in the morning and noon and between two and four o'clock in the afternoon. The minimum demand for water was between noon and one in the afternoon. Graff, Jr. supposed that the lull over the noon hour was due to the factories and their steam engines being stopped during the lunch period. Across the week, demand was lowest on Sundays and greatest on Saturdays. Other measurements indicated that the quantity used for industrial and other commercial purposes was 2,023,856 gallons per day.[83]

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In February of 1854, a development occurred which forever altered the nature of the City of Philadelphia. Often called the Great Consolidation, it had wide-ranging effects on the city's politics, institutions, infrastructure, businesses, and residents which continue to this day.[84] The

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[83] Watering Committee, *1852 Annual Report* (6 Jan 1853), 9.

[84] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §1 (Harrisburg: Boyd Hamilton, 1854), 21ff; Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873); Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 223, 230, 293ff, 307ff, 346ff, 352ff,

repercussions for the Fairmount Water Works and the water distribution system were significant.

Since its founding, the City of Philadelphia had consisted of the roughly two square miles bounded by the Delaware River on the east, the Schuylkill River on the west, Vine Street to the north, and South Street (called Cedar Street at the time) to the south. Over the years other municipalities had grown up around the City, among them the districts of Northern Liberties, Kensington, and Spring Garden to the north, the districts of Southwark and Moyamensing to the south, and the districts of West Philadelphia and Belmont to the west. Beyond these immediate neighbors were numerous other townships, boroughs, and unincorporated areas.

At the request of political and commercial leaders, the Pennsylvania state legislature in 1854 expanded the City of Philadelphia to the borders of Philadelphia County. More accurately, all of the districts, townships, boroughs, villages, and unincorporated areas which had surrounded the City of Philadelphia within Philadelphia County now ceased to exist and were combined into a much larger City of Philadelphia. The City of Philadelphia did not annex the neighboring municipalities. Rather, all of the municipal governments and organizations, including those of the City and the County, were dissolved and a single, new City of Philadelphia was created, defined by a new charter. This type of reorganization is called a consolidation.[85]

Initial calls for consolidation were a response to increasing cross-border lawlessness. The City of Philadelphia had no authority over the citizens, activities, or official policies in the

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356ff, 539ff, 706; Sam Bass Warner, the Private City (Philadelphia: University of Pennsylvania Press, 1968), 100ff; Michael P. McCarthy, "The Philadelphia Consolidation of 1854: A Reappraisal," *Pennsylvania Magazine of History and Biography,* Vol. 110 (Philadelphia: Oct 1986), 531ff; Andrew Heath, "Consolidation Act of 1854," *The Encyclopedia of Greater Philadelphia*, <https://philadelphiaencyclopedia.org/archive/consolidation-act-of-1854>, 2013, accessed 2 Jul 2019; "Chronology of the Political Subdivisions of the County of Philadelphia, 1682–1854," *Department of Records, City of Philadelphia* (2019), <www.phila.gov/phils/Docs/Inventor/graphics/wards/wards1.htm>, accessed 2 Jul 2019.

[85] Generally, if the municipalities surrounding a city are absorbed into the city and the original charter is kept, it is called an annexation. If the surrounding municipalities are absorbed and a new charter is created, it is called a consolidation. The latter is especially true if the county government is included—making the resulting city and county virtually the same entity.

neighboring areas. A thief, for example, could escape apprehension by simply running to the north past the city border at Vine Street into Northern Liberties. Although he could be plainly seen, the police in Philadelphia could not touch him. The police forces in Philadelphia and the surrounding districts were small and ineffective. There was a county sheriff but his authority was ambiguous and he was understaffed and underfunded. In order to quell disturbances, authorities were often forced to rely on the local militia who were at times slow to react for various reasons, not the least of which was the oft-times lack of reimbursement for the costs of previous callouts.[86]

Increased racial and ethnic tension fueled much of the unrest.[87] There were a little under 20,000 blacks residing in Philadelphia County in 1840; one third lived in the Moyamensing District just south of Philadelphia. Within the City about one out of twelve residents were black and forced segregation was still practiced. As the black middle class grew, however, white resentment of the competition for employment grew along with it.[88] Angry mobs often rioted in response to abolitionist activities. In the new state constitution in 1838 the Pennsylvania legislature nullified voting rights blacks had held since the adoption of the previous state constitution in 1790.[89]

Although the City was one of the major centers of abolitionism in the era prior to the Civil War, most Philadelphians did not subscribe to abolitionist beliefs. The mayor in 1835 claimed that 99 percent of residents were opposed to abolition.[90] Anti-slavery views were seen as destructive to the established order. Because many saw the alternatives to the status quo as either

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[86] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 359.
[87] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 353.
[88] *Hazard's Register of Pennsylvania* (1831), 172f; cited in Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982),, 293, 773n.150.
[89] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 294.
[90] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 294.

a race war or a mixture of the races—at the time considered dangerous either way—the abolitionist movement was perceived as subversive and any action taken against it was therefore rationalized as morally permissible.[91]

As the newly arrived Irish found themselves competing for jobs occupied by blacks, Irish-on-black violence increased as the 1830s progressed. Mobs attacked blacks and burned their residences. In 1838, abolitionists, who had earlier been denied locations to meet and speak, built their own building, Pennsylvania Hall near 6th and Arch Streets, and gathered for an anti-slavery convention. The speakers' roster included blacks and women. On the first night of the convention, three days after the hall opened, a mob broke in and set fire to the building, burning it to the ground. For two days rampaging continued, during which a Quaker charity for black children was burned and a black church was vandalized.[92]

The streets became increasingly violent. During an 1842 parade of a black temperance organization in Moyamensing, a municipality across the City line to the south, whites attacked the group and touched off a riot that lasted for two days, during which black men, women, and children were beaten and homes were looted. Only an intimidating response by the militia ended the riot.

Sometimes violence resulted from unexpected conflict. In 1843, for example, Irish weavers striking for higher wagers had rioted in protest of other weavers, mostly working from home, who declined to participate in the strike. Private homes, work equipment, and materials were destroyed. When the county sheriff arrived with a group of men in an attempt to disperse the mob, the outnumbered force was attacked and overwhelmed. The bloodied and beaten sheriff

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[91] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 295.
[92] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 295f; Sam Bass Warner, *The Private City* (Philadelphia: University of Pennsylvania Press, 1968), 132ff.

barely escaped with his life.[93]

The worst of the violence, however, was fueled by political Nativists who promoted the idea that Catholics wanted to turn America into some sort of monarchy that answered to the Pope. Over five days in early May, 1844, Nativist protests in the predominantly Irish municipality of Kensington, a suburb a little to the north of the City of Philadelphia, turned into a series of riots. Against a backdrop of street fighting and gunfire, Nativist rioters burned a Roman Catholic church and rectory, a fire company, a market, and numerous homes. A second Catholic church and parsonage, just inside the City itself, was burned before calm was restored.[94]

In July, some 2,000 rioters threatened a Catholic church in Southwark, on the southern border of Philadelphia. Joining Nativists in the street fighting were teenagers and young men who belonged to notorious gangs such as the Rangers, Killers, Bleeders, and Blood Tubs. The names were not mere posturing. The rioters used numerous types of weapons, including firearms and two cannon stolen from a ship on the nearby waterfront that they loaded with scrap iron, stolen tools, and scrounged silverware. A militia force of 190 soldiers, a handful of cavalry, and an artillery unit with three cannon of its own responded to protect the church. For the first time, the militia fired into the mob in an attempt to restore order. Armed fighting, including the use of cannon by both sides, lasted all night and into the next morning, resulting in approximately 15 dead, including three soldiers and around a dozen civilians, and approximately 45 wounded, including two soldiers and some 20 civilians.[95]

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[93] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884*, Vol. I (Philadelphia: L. H. Everts & Co., 1884), 661.

[94] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 357f; Zachary M. Schrag, *The Fires of Philadelphia: Citizen-Soldiers, Nativists, and the 1844 Riots Over the Soul of a Nation* (New York: Pegasus Books, 2021), 101ff, 148ff.

[95] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 357f; Zachary M. Schrag, *The Fires of Philadelphia: Citizen-Soldiers, Nativists, and the 1844 Riots Over the Soul of a Nation* (New York: Pegasus Books, 2021), 209ff, 233ff.

While the decisive application of force deterred further anti-Catholic violence, sporadic racially motivated aggression continued. In 1849, for example, crowds attacked a hotel owned and run by a mixed-race man married to a white woman. By the time the riot ended two days later, one black and three whites were killed and 25 people were injured.[96]

The threat of fire was another significant issue. While the city had no control over building methods and materials in neighboring municipalities, a spreading fire observed no borders. The City of Philadelphia had prohibited construction of wood buildings, but this did not apply in the municipalities outside the city. Even within the City there was no professional city fire department, only individual private fire companies that functioned as clubs for young men looking for excitement. Many of the fire companies had been organized along ethnic lines and great rivalries developed leading to regular street brawls. The ranks of many companies were filled with members of ethnic gangs. In some cases gangs completely took over fire companies, as when the Killers took over the Moyamensing Hose Company. Street fighting between fire companies had long been a problem, but the violence became more severe and frequent in the 1840s.[97]

Not all agreed consolidation was the answer. Property owners and those who had invested in loans to the City, led by prominent lawyer and politician Horace Binney, opposed the idea. They were concerned they would be taxed to pay off debts incurred by the suburban municipalities. Others were fearful that with consolidation the Whig politics dominating the City of Philadelphia would be overwhelmed by the Democratic Party which dominated the districts. The district Democrats, though, were nearly as leery of consolidation due to their fear of the

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[96] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 353.
[97] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 346ff.

strength of the Whigs.[98]

In 1844, the state legislature compromised by requiring all municipalities to maintain a police force consisting of one officer for every 150 taxable residents. The same year the City created a new militia consisting of artillery, cavalry, and infantry to serve as a peacekeeping force. After the rioting in 1849, the state created a cross-border police force commanded by an elected marshal and overseen by a police board. In 1844 the City began to regulate the fire companies, levying annual reporting requirements and fines for noncompliance. Four years later the state legislature gave the Court of Quarter Sessions authority over the fire companies in Philadelphia and the districts.[99]

Although early calls for consolidation had been in response to rioting, that had changed by the 1850s. Safety and security was not a dominant issue in the year leading up to the 1853 election. The incremental changes implemented by the City and the state legislature were having their effect. The editors of a local newspaper proclaimed in February 1854, prior to implementation of consolidation, that Philadelphia had "become the quietest and most orderly city in the Union, while every few weeks we hear of riots, rows, street brawls and midnight assassinations in New York and other cities."[100] While that was obvious hyperbole, it was true that the earlier lawlessness had largely been dealt with and was no longer seen as the problem it once had been.

Two other issues came to the fore instead—the increasingly unworkable nature of the political status quo and the worrisome, looming irrelevance of Philadelphia itself. These

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[98] Michael P. McCarthy, "The Philadelphia Consolidation of 1854: A Reappraisal," *Pennsylvania Magazine of History and Biography,* Vol. 110 (Philadelphia: Oct 1986), 542.
[99] John F. Watson, *Annals of Philadelphia, and Pennsylvania, in the Olden Time,* Vol. III (Philadelphia: Edwin S. Stuart, 1887), 412.
[100] *Evening Bulletin* (2 Feb 1854); quoted in Michael P. McCarthy, "The Philadelphia Consolidation of 1854: A Reappraisal," *Pennsylvania Magazine of History and Biography,* Vol. 110 (Philadelphia: Oct 1986), 535n,12.

existential concerns created a consensus for consolidation among the governing class which had not existed up to this time.

The political situation was increasingly regarded as untenable. Like everything else, politics was becoming increasingly complex. Just as a merchant, say, needed to devote himself to his commercial endeavors in order for them to succeed, it was beginning to be believed that a person needed to devote themselves to politics in order to be competent at governing. True or not, the part-time citizen-politician was increasingly perceived as an outmoded model. It was thought that what was needed were specialists; thus the rise of the professional politician.

Whether or not the dedicated politician was the answer, the political realities were becoming increasingly—and, to many observers, needlessly—complicated. There were 21 governing bodies between the City, immediate surrounding districts, and County Commissioners alone. In addition there were six boroughs and thirteen townships. In all there were forty corporate or semi-corporate municipal bodies in the county. There were nineteen sets of tax structures with their nineteen associated sets of tax collection methods. Consolidation was projected to eliminate at least 168 tax collectors and save $100,000 annually.[101] Perhaps more important, there were twelve distinct municipal debt structures. With so much duplication of services, and organizational structures, calls for consolidation increased as the costs of governing ballooned. The consolidation effort was in large part a government reform movement.

Added to this was the simple demographics of geography. Many of the neighboring municipalities were becoming as populous as the City of Philadelphia itself, some eventually more so. In 1820 the population of Philadelphia was 63,802 while the combined population of the three districts immediately to the city's north and the two to the immediate south was 45,007.

[101] The equivalent of approximately $3.5 million in 2022.

By 1850 Philadelphia's population was 121,376 and the districts' combined population was 218,669. From 1830 to 1840, Philadelphia's population increased 16.4 percent while that in the districts increased 118.8 percent. Industry was developing apace with population. It was becoming increasingly difficult for the City to expand its tax base relative to the surrounding areas and relative to the need for expanded city services like water, sewerage, and the paving, lighting, and cleaning of streets.

The City was facing a genuine threat of relative decline and the competition was not local only. Up until 1820 Philadelphia was the second most populous city in the nation, behind New York. By 1830 it had been supplanted in that position by Baltimore and by 1840 both Baltimore and New Orleans were ahead of it. New Orleans had fallen behind by 1850 but Baltimore and now Boston were larger. For the politically astute and civic-minded, the peril was impossible to ignore. As local lawyer and Whig politician Eli Kirk Price lamented, "It should not be that the city should sink to be an appendage of her own colonies, nor to stand in the sixth rank of American cities…" Without consolidation, he continued, Philadelphia would "…inevitably sink in relative importance…"[102]

The increasing competitive disadvantage was felt especially keenly after the profound economic and psychological blow of the dissolution of Philadelphia's Second Bank of the United States by the Jackson administration in the 1830s. Consolidation promised to prevent a twilight future of diminishing significance. Public support for consolidation had steadily grown; by the early 1850s the editorial boards of all of the major newspapers were in favor of it. Binney and nearly all of the earlier opponents had thrown in their support as well.

In October 1853 three pro-consolidation candidates from Philadelphia won election to the

[102] Memorial to Pennsylvania state Senate, 3 Jan 1854, quoted in Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873), 60.

Pennsylvania General Assembly—Price in the Senate and inventor and steam engine manufacturer Matthias W. Baldwin and merchant and financier William C. Patterson in the House. A non-partisan committee of over one hundred met twice a week in Philadelphia throughout October, November, and December to construct a charter for the proposed new City. Its minutes were published in the local newspapers.

Price presented the completed charter as a bill in the state Senate on 3 Jan 1854. After deliberation it was passed unanimously on 18 Jan and sent immediately to the House where the cause was taken up by Baldwin and Patterson. After making minor changes, the House passed the bill by a vote of 79 to three on 30 Jan. The next day the Senate concurred with the House's amendments and prepared a document for the governor's signature.

Fearing that officials in both the City and the districts were preparing to take on new debt for projects in the expectation they would not be responsible for repayment, Patterson and the state Assistant Secretary of State traveled by train from the evening of 1 Jan through the night and into the evening of the next day to chase down Governor William Bigler in Erie where he was working on official business. The governor was roused from bed to sign the bill, which he did shortly before midnight on 2 Feb.[103]

On Saturday 11 Mar there was a great celebration consisting of official visits, tours of local institutions, river excursions, banquets, public gatherings, and orations. Philadelphia's prospects appeared bright. "Who can doubt her future triumph?" proclaimed the governor after enumerating the City's attributes and accomplishments.[104]

Virtually overnight, the City of Philadelphia expanded from two square miles to just over

[103] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 360.
[104] Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873), 94.

130.[105] It now encompassed all of what had been Philadelphia County. This was the largest area of any American city at the time, surpassed only by Chicago in 1889 as it annexed surrounding communities. The population within the original City was a little over 121,300 in the 1850 U.S. Census. In 1860, the population of the consolidated City was over 565,500. All of the commercial and industrial activity of the metropolitan area was now within the City. This was a rapid political and economic reordering on an unprecedented scale.

The entire political structure was streamlined. Gone were the myriad of municipal governments and organizations. It is place was a single City government consisting of a popularly elected mayor serving for two-year terms and a bicameral City Council. The Select Council consisted of one popularly elected member from each of the 24 wards into which the City was now divided. The Common Council was composed of one member for every 1,200 taxable residents, 74 initially.

Executive functions formerly under City Councils were given to the mayor and executive branch, organized by department (police, water, etc.). Although oversight committees belonging to City Council still existed, the departments reported directly to the mayor. Previously appointed officials such as City Treasurer and Receiver of Taxes now became elected positions. A new elected position of City Controller was created to manage the city's general operations and spending.

Even the City's name reflected the change. The sleek, new "City of Philadelphia" replaced the cumbersome "Mayor, Aldermen, and Citizens of Philadelphia."[106] One historian has

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[105] In terms of land area. See U.S. Census Bureau, *Population of the 24 Urban Places: 1790,* <https://www.census.gov/population/www/documentation/twps0027/tab14.txt>, 15 Jun 1998, accessed 3 Jul 20218. If area over water is included (predominantly the Delaware River), the total becomes approximately 140 square miles.

[106] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §1 (Harrisburg: Boyd Hamilton, 1854), 21.

commented that with the Great Consolidation, as it has become known, Philadelphia had "completed shedding its old identity as a seaport city on the eighteenth-century model and became definitively a nineteenth-century industrial city."[107]

The engineers of consolidation were no starry-eyed idealists, however; they were thoroughly realistic about what it could and could not accomplish. In addition to integrity, moral courage, and experience in civil affairs, Binney listed "practicalness" high on the list of qualities which drove him to recommend Price be asked to lead the push for consolidation, for example.[108] Although the Act of Consolidation provided for punishment of official corruption, Price himself later noted in his published review of the Act and its history:

> Consolidation has removed many facilities and temptations to disorder and crime, but it could not promise to reform human nature; and many evils yet exist that only the people themselves can remedy, by electing true men to Councils, and to fill the municipal offices, and to represent them in the State and nation. They must ever be watchful and fearless in exposing and convicting the fraudulent and criminal, and thus purge their municipality, and their State and National representation of corruption.[109]

In this Price echoed founder and second President of the United States John Adams, who wrote in a 1798 letter to the Massachusetts Militia, "Our Constitution was made only for a moral and religious People. It is wholly inadequate to the government of any other."[110]

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[107] Elizabeth M. Geffen in Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 308.
[108] Horace Binney to Horace Binney, Jr., 23 Jun 1853; quoted in Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873), 20.
[109] Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873), 86.
[110] John Adams to Massachusetts Militia, 11 October 1798, Founders Online, National Historical Publications & Records Commission, National Archives, <https://founders.archives.gov/documents/Adams/99-02-02-3102>, accessed 9 Jul 2019.

Figure 6-1. Map of Philadelphia, showing municipalities consolidated in 1854.

Background map courtesy City of Philadelphia, Bureau of Engineering, City Plans Division (18 Aug 1959), public domain.

While consolidation didn't resolve all of the City's problems, of course, it did go a long way toward reaching many of the goals of its promoters. The City was unified and much duplication of effort and costs was eliminated. Although public violence had largely diminished, a strengthened mayor with a police force directly reporting to him curtailed it further still. The existential threat of municipal obscurity was reversed.

In some ways post-Consolidation politics was simpler; in other ways, however, it was more complicated. Governing a huge metropolis was a complex business. There were many constituencies, often with conflicting interests. It took time to figure out how to work the new system. Some of the organizational changes were not as robust as expected. By empowering the oversight committees and exercising its funding authority, for example, City Council drew back some of the executive power that was given to the mayor. Many difficult problems remained; expected improvements were slow in coming. And of course the expanded electoral politics was subject to its own corruption as well, as Price alluded to. As is so often the case, it was an example of two steps forward, one step back. On balance, however, consolidation had a net positive effect on the development of the region.

The management of the water supply system was significantly affected by the consolidation. Like everything else, it had a dramatic shift of scope. Before 1854 the Fairmount Water Works—situated, perhaps ironically, outside Philadelphia on property purchased by the City—was the sole source of water for the original City and the districts of Southwark and Moyamensing. The managers of Philadelphia's water supply system had been responsible only for Fairmount and its distribution system, consisting of the Fairmount Dam, Fairmount Water Works, Fairmount Reservoir, Corinthian Avenue Reservoir, and the distribution system of mains. Now, after consolidation, they were responsible for all of the other water supply and distribution systems previously built or under construction in the former districts as well.[111]

Prior to consolidation, two of the districts had constructed their own water pumping and distribution systems and a third was under construction. The district of Spring Garden had built the Spring Garden Works on the east bank of the Schuylkill River about a mile above Fairmount,

[111] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §37 (Harrisburg: Boyd Hamilton, 1854), 41.

Kensington constructed the Delaware Works where that district fronted the Delaware River, and West Philadelphia district was working on the West Philadelphia Water Works on the west bank of the Schuylkill River about 1½ miles above Fairmount. (The West Philadelphia Water Works would be known as the 24th Ward Works when it was completed a year after consolidation.) In addition, although Southwark and Moyamensing had purchased their water from the Fairmount-supplied Philadelphia system they each had constructed their own distribution systems.[112] All of these systems now had to be knitted together into a cohesive whole.[113]

With consolidation, all of these systems needed to be integrated. It was a major undertaking for the new Water Department. Every element had to be newly assessed and evaluated.

Until 1854, what we might call the "head of the water department" was the Chairman of the Watering Committee, a member of City Councils. The members of the committee served as the management team and the Superintendent of the Fairmount Water Works acted as what we think of as the director of operations.

Under consolidation, the Superintendent of the Fairmount Water Works was elevated to become head of the entire Department. The new position was called the Chief Engineer, responsible for Fairmount and all the other systems. Each of the works had its own Engineer which ran its operation. The newly enlarged organization was called the "Department for Supplying the City with Water"—the Water Department for short.

Instead of reporting to the City Councils as the Watering Committee had, the Water Department reported to the mayor. The Watering Committee was replaced by an advisory Committee on Supplying Water (usually called the Committee on Water), composed of twelve

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112 Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 9ff.
113 There were also two small private systems, in Germantown and Chestnut Hill.

members, six each from the Select and Common Councils.[114]

The Chief Engineer was elected annually by voice vote of the members of the Common and Select Councils during a joint meeting.[115] Frederic Graff, Jr. had been the Superintendent of the Fairmount Water Works; he was now elected Chief Engineer of the Water Department.[116]

Fairmount had supplied water to the original City and the districts of Southwark and Moyamensing; after consolidation it supplied Wards 1 through 10, or virtually all of the City south of Vine Street.[117] The Spring Garden Works had supplied the districts of Spring Garden, Northern Liberties, and Penn; renamed the Schuylkill Works,[118] it now supplied Wards 11 through 15, part of Ward 16, and all of Ward 20. The Delaware Works, which supplied the Kensington and Richmond neighborhoods, now supplied Wards 17 through 19 and part of Ward 16. The West Philadelphia Works, still under construction, was renamed the 24th Ward Works for the ward it would supply when completed.[119]

Whereas Fairmount had supplied nearly 2.3 billion gallons in 1853, the combined system, after the Twenty-Fourth Ward Works was completed, met a demand in 1856 double that, or over 4.6 billion gallons.[120] Fairmount's distribution system consisted of a little over 120 miles of cast

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[114] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §50 (Harrisburg: Boyd Hamilton, 1854), 45. Water Department Annual Reports from this period show that the committee was composed of twelve members, six from each chamber.
[115] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §9 (Harrisburg: Boyd Hamilton, 1854), 27f.
[116] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 3.
[117] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 3f.
[118] The steam-powered water works originally constructed by the commissioners of the Spring Garden municipality in 1844 was known as the Spring Garden Works prior to the Consolidation. From 1854 to 1876 it was known as the Schuylkill Works. From 1877 until its decommissioning in 1909 it was known again as the Spring Garden Works.
[119] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 4.
[120] Cf. Water Department, *Chief Engineer's 1853 Annual Report* (5 Jan 1854), 7; Water Department, *Chief Engineer's 1856 Annual Report* (12 Jan 1857), 21. Beginning with the Annual Report for 1855, the unit of water volume was changed from the ale gallon to the wine gallon, which by that time had become broadly adopted for water systems throughout the United States. See Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 5. The 231-cubic-inch wine gallon is 18.1% smaller than the 282-cubic-inch ale gallon. (It is equal to the modern US gallon and approximately equal to 3.8 litres.) For clarity of comparison, both figures are reported here in ale gallons.

iron pipe; post-consolidation, the Water Department's responsibility immediately doubled to over 242 miles.[121] The storage capacity, however, only increased 40 percent, from a little over 47.2 million gallons to just over 66.3 million gallons.[122]

No longer was water the only source of power for Philadelphia's water system. In fact, every pumping station but Fairmount was powered by steam. In one sense there was a benefit in having the two types of power. Fairmount supplied a large percentage of water in the consolidated system without the cost of fuel necessary for steam-powered systems, but when the water-powered system struggled during dry periods, the steam systems could pick up some of the slack. The chief engineer of the Department, however, now had to be an expert in both water and steam power.

Perhaps the greatest challenge to integration was the array of separate distribution systems. Although Fairmount's system of distribution had served as a model for those in the surrounding districts[123] there had been no attempt to design them to be compatible. As a later chief engineer put it, "several of then [pre-Consolidation] independent corporations had arrangements for supply of their districts, and no cooperative system had existed or even been considered."[124]

Fairmount's original distribution system, which now formed the core of the larger system, was a well-conceived network of mains ranging from thirty inches in diameter to twenty, sixteen, twelve, and ten inches, stepping down in an organized fashion. Short six-, four-, and three-inch feeder pipes completed the distribution (although the three-inch pipes were proving to

[121] Cf. Water Department, *Chief Engineer's 1853 Annual Report* (5 Jan 1854), 8; Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 28.
[122] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 27. The Fairmount and Corinthian Avenue Reservoirs had a combined capacity of 47,218,028 gallons.
[123] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 10.
[124] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 36.

be problematic).[125] It was surrounded, however, by a patchwork of less-well-designed distribution systems. In the areas of the former districts, some of the mains were simply too small; others sometimes stepped down in size along a street and then stepped back up, impeding the proper flow of water. In order to save money, some of the districts had allowed and even requested developers and other property owners to lay their own mains along streets. Without proper oversight this resulted in a hodge-podge of sizes and quality of materials. Defective installations—with attendant failures and wasting of water—were common.[126]

Records-keeping was a daunting exercise all its own. Clerical and accounting practices had been inconsistent between the districts, sometimes within a district itself. In some areas, properties had been allowed to change hands or additional water facilities added without billing being updated.[127] Some areas required a house-by-house examination of properties to reconcile out-of-date records with accurate information. All of the books had to be standardized across the City. This alone took over two years to accomplish.[128]

Cramped office space made everything more difficult. With the expansion of functional and geographic responsibility came a necessary increase in the number of staff. Water Department clerical workers were not the only ones who found it difficult to squeeze into the old quarters; the numerous customers paying their water bills in person magnified the problem. The initial inability to physically accommodate the public, combined with the new clerks' unfamiliarity with many portions of the new City, resulted in overflowing crowds, lengthy

[125] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 9f.
[126] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 10f, 18f, 22; Water Department, *Chief Engineer's 1856 Annual Report* (12 Jan 1857), 33ff.
[127] Recall that water service in Philadelphia was not metered until the early twentieth century. At this time, customers were charged "water rents" which were dependent upon the number of water facilities (sinks, spigots, etc.) on the property.
[128] Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 14.

waiting, and "bitter complaint."[129]

Reorganization of the greatly increased system became the responsibility of Frederic Graff, Jr. His descriptions of the multiple pumping stations in the annual report for 1854 show how much needed to be done to rework the separate entities into an efficient city-wide water supply system. The annual reports for the years 1855 and 1856 also paint a picture of the hard work of integrating the numerous components into a workable whole.[130] The change may be compared with that faced by a business which because of growth and acquisition quickly expands from a small company with limited reach to a large corporation with a large number of properties, a variety of physical plants, separate workforces, differing management systems, and distinct rules and work cultures. Melding the dissimilar infrastructure into a well-functioning system and a diverse staff into a cohesive organization was a challenging proposition.

Graff, Jr. may have acquired the responsibility for both water and steam operations, but he was careful to point out the comparative expense of steam at the time. In his Annual Report for 1854 he noted that for every million gallons of water pumped per day on average, Fairmount cost only $1.50,[131] while the steam-powered Schuylkill Works and Delaware Works cost $13.36[132] and $18.16[133] respectively.[134]

One of the benefits of consolidation was the increased reach of the City's control of the Schuylkill River. Before 1854 the City of Philadelphia directly controlled only a one-mile stretch of the river, roughly centered on Market Street. Consolidation extended the City's control of the Schuylkill River, like much else, to the former county boundaries—approximately four and a

[129] Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 15f.
[130] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855); Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856); Water Department, *Chief Engineer's 1856 Annual Report* (12 Jan 1857).
[131] The equivalent of approximately $52.89 in 2022.
[132] The equivalent of approximately $400.54 million in 2022.
[133] The equivalent of approximately $640.29 million in 2022.
[134] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 33f.

half miles upstream of Fairmount along the west bank and nine miles along the east. This made it possible for the City to control the disposal of waste into a larger portion of the river.

The Act of Consolidation directed City Councils to establish public parks for "health and enjoyment."[135] On 15 Sep 1855, City Councils used this authority to take a significant step toward the protection of the cleanliness of the water in the Schuylkill River. Recall that the Lemon Hill estate, located on a bluff above the east bank of the Schuylkill River just upstream of the Water Works, was purchased by the City in 1844. Since that time it had been leased to a private contractor for the operation of a German beer garden concession. Although the recreation and refreshment concession was allowed to continue, Councils canceled the lease of the property and brought it under the City's direct control. It combined the tract with the original thirty acres at Fairmount[136] and renamed the grounds Fairmount Park.[137] When the Sedgley estate, just to the north of Lemon Hill, was added in 1857, the total area grew to 110 acres and stretched from the Wire Bridge just below Fairmount at the south to the Girard Avenue Bridge at the north.[138]

To further protect the water supply, Graff, Jr. proposed in his Annual Report for 1855 the construction of an interceptor sewer parallel to the Schuylkill River on its east side. An interceptor would catch waste from the 24th Street sewer and other drains which were then emptying into the river and would carry it beneath Pennsylvania Avenue to be discharged at a point below the Fairmount Water Works thereby preventing it from contaminating the water

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[135] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854*, No. 16, §39 (Harrisburg: Boyd Hamilton, 1854), 43.
[136] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 8.
[137] Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 5; Fairmount Park Commission, *1878 Annual Report*, May 1878, 47.
[138] Sidney Adams, *Plan of Fairmount-Park* (1859), Historical Society of Pennsylvania. Fairmount Park would eventually grow to over four thousand acres within the Schuylkill River and Wissahickon Creek watersheds. The grounds of the Fairmount Water Works and, more narrowly, the South Garden are considered the nucleus of that great park.

supply.[139] Unfortunately, it would be over three decades before Graff's recommendation was acted upon.

In 1855 Graff, Jr. barely won re-election to the position of Chief Engineer of the Water Department. Nominally a Whig,[140] yet determinedly apolitical,[141] he was solidly supported by the Democratic Party caucus in Councils and tepidly supported by the Whigs, but opposed by the Native American[142] (or "Know-Nothing") party.[143] In July of the next year, however, following a mayoral election in May which saw Democrat Richard Vaux elected mayor following the Whig administration of Robert T. Conrad,[144] Graff was unseated.[145] This time the Democrat caucus in Councils had turned against him and nominated their own candidate, Samuel Ogdin,[146] who had been the chief engineer of the Spring Garden Works for a number of years prior to consolidation.[147] Graff lost to Ogdin by an overwhelming margin, while the Know-Nothing

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139 Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 5f.

140 "King Caucus Resisted," *Sunday Dispatch* (Sunday 13 Jul 1856), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 83-1; undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 98-1. Philadelphia Water Department Historical Archives, Accession 2004.071. 001.

141 "Memoir of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519.

142 The Native American Party, also known as the American Party and the Know-Nothing party, was an influential but short-lived third-party movement during the late 1840s and 1850s. Neutral on slavery, strongly opposed to legal immigration, and bitterly anti-Catholic, the party rose to prominence as the Whig party declined. At its height, the party elected dozens of congressmen and numerous governors, and controlled various state legislatures. It soon foundered, however, upon the same rocks as the Whig party. As the slavery issue became far more important to most Americans than immigration, the Native American Party fractured and eventually disappeared. The nickname "Know-Nothing" was first used as a descriptive in New York in 1853 because members had been encouraged to reply "I know nothing" if asked about the party and its aims.

143 "Driven to Desperation," undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 37-7; "A Sad Disappointment," undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 38-2. Philadelphia Water Department Historical Archives, Accession 2004.071. 001. The vote was 49–45 (variously reported as 49–44) for Graff over Native American candidate Frederick Erdman. Five Native American councilmen joined the Democrat block; the Whigs split.

144 Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 369f.

145 *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 204.

146 "Loco Foco Consistency," *The Daily News* (Sunday 12 Jul 1856), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 97-6; "King Caucus Resisted," *Sunday Dispatch* (Sunday 13 Jul 1856), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 83-1. Philadelphia Water Department Historical Archives, Accession 2004.071. 001.

147 "The Kensington Water Works," unknown newspaper clipping (Monday 25 Aug 1856), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 97-5. Philadelphia Water Department Historical Archives, Accession 2004.071. 001. The Spring Garden Works became known as the Schuylkill Works after the Consolidation.

candidate was not a significant factor.[148]

For the first time since 1805, a Graff was not overseeing the Philadelphia water system. The editor of a local newspaper was puzzled by the move, remarking that Graff, Jr. "was admirably qualified by his industry, integrity, talents and scientific acquirements, all of which were brought to bear in the discharge of the various and arduous duties which devolved upon him." The editor further lamented:

> When a man so competent in every way to fill the office is removed, we are at a loss to know what good is to be effected by the change. The importance of having the City Water Works well and ably conducted in all its departments is obvious to every one [*sic*], and no man more faithful or competent in this respect can be found than the late incumbent. His removal will be a public loss.[149]

Ogdin immediately began warning that the capacity of the current system would soon be insufficient to meet the growing demand for water. Fairmount was operating near its maximum output keeping up with the demand, especially during the hot summers, and would soon be overwhelmed if nothing was changed.[150] The Schuylkill Works wasn't yet operating near its maximum pumping capacity but its reservoir held less than a two day's supply of water.[151] The Twenty-Fourth Ward Works had its own issues, including poor workmanship of its buildings and the complete lack of a reservoir.[152]

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[148] Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 92-3. Philadelphia Water Department Historical Archives, Accession 2004.071. 001. The vote was 60–37 for Ogdin. One vote was cast for Frederick Erdman, once again the Native American candidate. At the time, the Common Council consisted of 74 members and the Select Council 24. These and other newspaper accounts contradict the obituary of Graff, Jr., published in *Journal of the Franklin Institute* in 1890, which describe him as having "resigned." See "Memoir of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519.

[149] *Pennsylvania Inquirer,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 104-6. Philadelphia Water Department Historical Archives, Accession 2004.071. 001.

[150] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 4f, 22.

[151] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 9.

[152] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 17ff; "The Water Department," *The Sunday Atlas* (7 Nov 1858).

Most problematic of all was the Delaware Works in the Kensington neighborhood. Demand was already beyond its pumping capacity[153] but Ogdin thought funding any expansion would be throwing good money after bad.[154] This was because the water it drew was horribly polluted with little hope of improvement. As Graff, Jr. had pointed out two years earlier, its intake was situated on the Delaware River "but a few hundred feet below the mouth of Gunner's Run,"[155] a short canal into which waste from a dye factory, offal from abattoirs and a fish cleaning operation, and sewage from other sources were drained. Exacerbating the matter, the configuration of the riverbank in that area created an eddy which concentrated the waste from the canal and from wharves on the river and prevented it from being carried downstream.[156] Ogdin was so concerned about the filthy water that he had a sample analyzed. The chemist's report was striking:

> The water from the Kensington Water Works,[157] abounding with scum and sediment is so foul from putrifying [*sic*] organic matter, apparently of animal origin, that a chemical examination of it would be useless. I would not be willing personally to use the water from which the sample was drawn, nor even water which had a remote connection with it, believing it to be injurious to health.[158]

Although it was evident that there was a need to increase the water supply throughout the City to match the increasing demand, Ogdin, echoing Graff, Jr. just a few years earlier,[159] twice

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[153] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 22.
[154] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 23.
[155] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 22. Gunner's Run was also known as Gunnar's Run, Aramingo Creek, and Aramingo Canal.
[156] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 13f.
[157] At the time, the Water Department called this the Delaware Works.
[158] Professor James C. Booth to Samuel Ogdin, 29 Jul 1856, quoted in Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 13, and Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858), 15.
[159] Water Department, *Chief Engineer's 1854 Annual Report* (19 Apr 1855), 22.

recommended the Delaware Works be shut down.[160] In order to mitigate the loss of the pumping capacity, he proposed feeding its reservoir via a connecting main from the reservoir of the Schuylkill Works, where there was still reserve capacity. Linking the distribution system in Kensington in this way would be less expensive than expanding the works, it would greatly improve the quality of the water, and it would solve the problem of low water pressure seen in some areas of the former district.[161]

In order to increase overall capacity, Ogden twice proposed building an additional steam-powered pumping station in the northern portion of an area called the Flat Iron, a wedge-shaped industrial area on the east bank of the Schuylkill River immediately upstream of the Fairmount Dam between Fairmount and Lemon Hill. The site he recommended was the location of Lloyd's Canal, a short waterway at the foot of Lemon Hill. Although the proposed water works would require a 3,000-foot main to supply the reservoirs of both the Schuylkill and Delaware Works, Ogdin believed "The erection of the Water Works at this point would in no way interfere with the contemplated public park embracing the same property, as all the necessary structures could be made in ornamental style."[162] His recommendation seems to have been ignored.

Another proposal by Ogden attempted to solve the problem of low water pressure in certain portions of the City where there was a small head of water. Ogden recommended construction of a network of standpipes into which water could be pumped to elevated heights in order to achieve a greater head and thereby supply water to customers at a higher pressure. He suggested a standpipe be erected in each of the public squares and a reservoir constructed in the

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[160] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 23f; Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858), 32.

[161] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 23f; Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858), 31f. This recommendation was finally implemented 23 years later, in 1879.

[162] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 24f; Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858), 33.

southwestern part of the City.[163] Although these proposals were innovative, none of them were adopted.[164]

Samuel Ogdin led the Water Department for only two years, likely because his tenure was clouded by charges of corruption.[165] In the spring of 1857, Charles V. Hagner, the Select Councilman from the 15th Ward,[166] received an anonymous letter[167] detailing a long list of fraudulent activities allegedly committed by Ogdin, including selling iron from the City's public yard without authorization and at discount prices to a foundry run by his brother James Ogdin,[168] purchasing articles from the same foundry at inflated prices, purchasing materials from other providers at inflated prices, failing to submit to the City Treasurer payments received, allowing various parts and equipment to be hauled away without payment, paying various vendors for services which were unnecessary or not rendered, paying a contractor for nonexistent employees, using Water Department employees for personal work, creating official positions without the authority to do so, and paying the holders of those positions extravagant salaries.[169] Although the accuser was unknown, the person identified nineteen men who together could verify the charges.[170]

Discreetly following up on a few of the accusations on his own, Hagner concluded they

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[163] Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 25f; Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858), 34.
[164] See Water Department, *Chief Engineer's 1857 Annual Report* (21 Jan 1858) and subsequent Annual Reports.
[165] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendices 98 & 99 (Philadelphia: 1857), 177ff, 201ff.
[166] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 178.
[167] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 210.
[168] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 186.
[169] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 205ff.
[170] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 209.

were credible enough to be brought before the Councils' Committee on Water for a deeper inquiry.[171] At first, Ogdin objected to a possible investigation[172] and the committee agreed, saying that anonymous allegations weren't worth considering.[173] When he learned that the Registrar of the Water Department had arranged to advertise in the local newspapers for the unknown accuser to come forth, however, Ogdin changed his mind, decided to get ahead of a possible public scandal, and requested an investigation.[174]

When no one responded to the Registrar's call, the Committee on Water deposed and examined the named individuals and others[175] but by July decided that the charges of malfeasance while in public office could not be sustained.[176] A lone committee member, Common Councilman Andrew Miller, submitted a dissenting report.[177] In his view many of the charges were obviously true, being "clearly and substantially proven, in every important particular"[178] by testimony and examination of the records.[179] Miller went so far as to interview certain individuals the full committee had ignored.[180] In his detailed report he contended that by overlooking key questions and declining to follow up on potential leads, the committee failed to

[171] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 210f.
[172] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 178.
[173] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 178f.
[174] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendices 98 & 99 (Philadelphia: 1857), 179, 201ff, 203.
[175] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 211ff.
[176] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 99 (Philadelphia: 1857), 201, 204f.
[177] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 177ff.
[178] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 184.
[179] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 194.
[180] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 183.

fully investigate the charges. He suggested that the members of the Committee on Water were attempting to cover up the affair because some of them had knowingly benefited from Ogdin's misconduct by arranging for family members to be hired by him.[181]

Miller called for Councils to open a more thorough investigation conducted by a special joint committee convened under the authority of Section 50 of the Act of Consolidation,[182] but Councils rejected the recommendation. Although not a member of the water committee, Councilman Hagner joined Miller in condemning Councils' failure to vigorously investigate the charges. On the floor of the Select Council chamber, he read out:

> This affair, sir, shall not be smothered up and whitewashed over without an effort on my part to prevent it. The oath of fidelity to the city I have taken here—my sense of duty—the reputation, honor and interest of the party in the ascendancy in these Councils, of which I am an humble member, all require this at my hands.
>
> I therefore make this statement and the charges contained in it, publicly, before these Councils and the citizens of Philadelphia, which I shall take care to have published for their information, acknowledging my responsibility here or anywhere, for their truthfulness.

Hagner listed three charges he believed had been proven, before continuing:

> Some of these charges are proved by documents on our files, others by documents on file at the office of the Controller, which were all within the reach of the Committee, and could have been easily procured by a simple call on that officer. I understand that such a call was proposed by a member of the Committee, and resisted by a majority then present.

He referred as well to Miller's report:

> There are many other charges, which, in my opinion, require a thorough

[181] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 181.
[182] *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 98 (Philadelphia: 1857), 195.

> investigation…[183]

No "thorough investigation" was forthcoming, but while Ogdin may have been officially cleared, his reputation was damaged. The charges leveled against him were published in local newspapers,[184] as were the water committee's report,[185] Miller's detailed objection,[186] and Hagner's remarks in Select Council.[187]

When Ogdin was nevertheless re-elected a year later[188] a local newspaper editor opined:

> We call attention to the report of Andrew Miller, Esq., to be found in another column. This Report, in connection with the expose [*sic*] of Mr. Hagner in Select Council, make out an unanswerable case against Engineer Ogden [*sic*]. Documentary evidence makes it absolutely certain he did retain over $500 of funds due to the City[189] until fear compelled him to pay the amount into the Treasury—that he has still in his hands sums of money due the City, which he has not yet paid over, and that without authority of law, he has created high salaried officers and expended the city money upon them. It is also clear that he has used his official station to swell the profits of the private business firm of which he is a member, by selling old materials to them at nominal prices or corruptly low prices, and by purchasing

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183 Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-6. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

184 "Copy of the Charges," *Pennsylvania Inquirer,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 94-2–94-4; "Common Council," undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-1 and 96-2; "Promises of Reform—How They Have Been Kept," *The Daily News* (Wednesday 28 Apr 1858), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 99-1–99-3; "Promises of Reform—How They Have Been Kept," *The Daily News* (Wednesday 28 Apr 1858), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 111-3. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

185 "Proceedings of City Councils," *Philadelphia Inquirer,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 95-1–95-4; undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-6. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

186 "Rich Disclosures: Minority Report in the Ogden [*sic*] Peculating Case," *Pennsylvania Inquirer,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 93-1–94-2. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

187 Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-6. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

188 Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-2. Philadelphia Water Department Historical Archives, Accession 2004.071.001. Ogdin received 67 votes and Graff received only two votes. A third candidate received twenty.

189 The equivalent of approximately $18,000 in 2022.

> article for City use from this firm at exorbitant prices. It appears, too, that Ogden [*sic*] has subsidised the Water committee by employing relatives of a majority of them in the Water Department.
>
> And yet this man is re-elected! …
>
> Mr. Miller is getting back, we hope, to his ancient ideas of reform and party purity. Let him keep up the steam—go ahead—and drag corruption…from its municipal hiding places, and public commendation will be his.[190]

Another editor thought the water committee's reports should be required reading by every citizen when they were considering which City Council candidates to vote for:

> We have shown some of the ways in which Loco Foco[191] politicians manage to extract the money from the public treasury while they are endeavoring to amuse the people with the cry of economy and reform. … The reports of the majority and minority of the Water Committee in the case of Samuel Ogden [*sic*], Chief Engineer of the Water Works, and the testimony appended thereto…throws much light upon the engineering of an important department of the City government, and should be read by every tax payer before he casts his vote.[192]

In May 1858, Mayor Richard Vaux lost re-election to Republican Alexander Henry. With the shift in party influence, two months later Ogdin lost re-election in Councils decisively to Henry P. M. Birkinbine.[193] If even one or two of Ogdin's actions were as described by

[190] Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 96-4. Philadelphia Water Department Historical Archives, Accession 2004.071.001.
[191] A faction of the Democratic Party. Although faded by this time, the term was still sometimes used in a derogatory manner by political opponents.
[192] "Promises of Reform—How They Have Been Kept," *The Daily News* (Wednesday 28 Apr 1858), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 111-3. Philadelphia Water Department Historical Archives, Accession 2004.071.001.
[193] Clipping from unknown newspaper, (1 Jul 1858), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 130-8. Philadelphia Water Department Historical Archives, Accession 2004.071.001. Birkinbine received 75 votes in Councils, Graff 17, and Ogdin 10.

Councilmen Miller and Hagner, his service as Chief Engineer was appropriately brief.

Henry Peter Miller Birkinbine (21 May 1819–21 Apr 1886)[194] was a classic example of a self-made man. Born in Reading, Pennsylvania, his father had died when Henry was just seven years old.[195] Largely an autodidact, he worked and studied his way up from machinist to engineer to business executive. He early on learned to design and construct machinery for coal mining operations. Bringing his expertise to Philadelphia in 1845, he founded two successive companies, Birkinbine & Martin followed by Birkinbine & Trotter, both manufacturing a range of heavy equipment and specializing in hydraulic engineering.

Prior to the Great Consolidation, Birkinbine led the planning and construction of the water works for the borough of Germantown, just north of Philadelphia, completing it in 1851.[196] The challenge there was to construct a pumping station and distribution system for the hilly area where the water source was only a small stream called Papermill Run.[197] Part of Birkinbine's solution was the first standpipe in America; he successfully employed a steam engine to pump water into it to a height where it could provide the pressure necessary to force water to homes in elevated portions of the municipality.

This was followed by Birkinbine's design and construction of the West Philadelphia Water Works, which became the 24th Ward Works when the area became part of Philadelphia 1854.[198] Completed in 1855, the station was powered by steam and took water from the west bank of the Schuylkill River, upstream from the Fairmount Water Works. It too included a

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[194] "Henry P. M. Birkinbine," *Journal of the Franklin Institute*, Vol. 92, Jul–Dec 1886 (Philadelphia: 1886), 302ff.
[195] "John Birkenbein [*sic*]," *Find A Grave*™ (1 Oct 2009), <www.findagrave.com/memorial/42594582/john-birkenbein>, accessed 26 Jul 2019.
[196] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 47.
[197] Known today as Monoshone Creek.
[198] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 39ff. *Journal of the Common Council of the City of Philadelphia: 11 May–13 Nov 1857,* Appendix 63 (Philadelphia: 1857), 131ff.

standpipe, partly for the same reason as at Germantown.[199] Birkinbine also designed the water works for the towns of Reading and York, Pennsylvania.

After his time with the Water Department of Philadelphia, Birkinbine worked as a consulting engineer and contributed his sought-after expertise to the design of water systems in the growing Pennsylvania municipalities of Harrisburg, Allentown, Bethlehem, Lancaster, and Lebanon. A lifetime member of the Franklin Institute, he served on the Board of Managers from 1851 to 1856. He held numerous patents for innovative solutions he created in response to engineering problems he encountered throughout his lifetime.

As Chief Engineer, Birkinbine was anything but passive. His first Annual Report, for 1858, included a special supplement, "Report of the Chief Engineer of the Water Works in Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,"[200] in which he sought funding for a survey of water sources that could be made available to the city by connecting to streams and creating storage reservoirs comparable to what had been done in some cities in Britain.[201] Birkinbine included in the report an initial analysis of such far-flung sources as the Delaware and Lehigh Rivers above Easton and the Schuylkill River above Reading.[202] He also re-analyzed the existing City-wide system and began making recommendations for ways to increase capacity in order to meet the increasing demand.

One of the first things Birkinbine recommended was that the Corinthian Avenue

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[199] This standpipe was later criticized for being too small, but Birkinbine asserted that the West Philadelphia municipal leaders had not only eliminated a reservoir as a cost-cutting move but insisted on a standpipe design smaller than he had recommended. Birkinbine in 1859 proposed constructing the reservoir as originally intended. See Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.*, 128-7, Philadelphia Water Department Historical Archives, Accession 2004.071.001; Water Department, *Chief Engineer's 1856 Annual Report* (22 Jan 1857), 17ff; Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 48f; Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 39f.

[200] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 37.

[201] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 39f; Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 107.

[202] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 38f.

Reservoir embankments be raised nine feet, which would bring its water level to the same height as the Spring Garden Reservoir. He estimated the improvement would cost $32,000.[203]

The City approved Birkinbine's proposal and in 1859 construction at the Corinthian Avenue Reservoir was begun using stone quarried from Fairmount.[204] By the end of the year, it had already cost $37,500;[205] Birkinbine estimated it would cost another $8,500 more to complete.[206] It still wasn't finished at the end of 1860 after spending an additional $18,722[207] and Birkinbine projected $7,000 more[208] would be needed. The project was finally finished in 1861 with an additional $5,414 expended,[209] bringing the total to $61,636.[210]

The raising of the water level within the Corinthian Avenue Reservoir also necessitated lengthening the Standpipe. Although it was constructed to assist the pumps at Fairmount, the system still struggled to deliver water up to Corinthian Avenue. Birkinbine initially proposed raising the Standpipe's height by ten feet[211] but eventually judged it to be insufficient and in 1859 added 21 feet instead,[212] bringing its total height to 71 feet.

The improvement to the Standpipe cost $1,556;[213] since it was an integral part of the Corinthian Avenue Reservoir project, the total for the overall project came to $63,192,[214] nearly

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[203] The equivalent of approximately $1.14 million in 2022.
[204] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 99.
[205] The equivalent of approximately $1.3 million in 2022.
[206] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 99. The amount was the equivalent of approximately $303,300 in 2022.
[207] The equivalent of approximately $668,100 in 2022.
[208] The equivalent of approximately $249,800 in 2022.
[209] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 74. The amount was the equivalent of approximately $182,200 in 2022.
[210] The equivalent of approximately $2.1 million in 2022. The approximate current dollar amounts do not precisely add up due to inflationary changes to the value of the dollar between 1859 and 1961.
[211] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 40.
[212] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 99; Frederick Graff, Jr., *Notebooks,* c.1872. Philadelphia Water Department Historic Archives, accession 2004.062.003.
[213] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 94. The amount was the equivalent of approximately $55,500 in 2022.
[214] The equivalent of approximately $2.13 million in 2022.

twice the original less than three years earlier.

Birkinbine's administration saw the implementation of numerous other improvements, some greater, some lesser. Among the latter, by 1859 the stop-house, the wood-frame structure surrounding the taper pipe where the ascending mains from the Mill House connected to the base of the Standpipe, had deteriorated beyond repair and was replaced with stone construction. The new roof was a brick barrel vault atop which a walkway was built to connect the Mercury Pavilion with the terrace around the Standpipe.[215] Of greater significance, the same year the wood teeth of the Test Turbine's bevel gears were replaced.[216]

Since Fairmount continued to flourish as a public attraction,[217] the grounds needed periodic renewal. The buildings were repainted,[218] dead trees were replaced, and erosion gullies on the reservoir slopes were regraded and sodded. Damage to the grass caused by goats that had been allowed to roam the grounds was repaired.[219]

Construction of the North Garden, in the area immediately to the north of Fairmount Reservoir, was begun in 1858 and completed in 1860. Considerably larger than the South Garden,[220] it was laid out with walkways, benches, and grass plots, in addition to "three hundred choice shade trees and evergreens."[221] The area also contained two fountains. Water from the upper fountain, which featured jets which could be easily varied, flowed into a lower fountain, often called the "Mushroom Fountain," probably because of the shape of its waterplay. From the

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[215] Water Department, *Chief Engineer's 1859 Annual Report,* (9 Feb 1860), 59.
[216] Water Department, *Chief Engineer's 1859 Annual Report,* (9 Feb 1860), 59.
[217] Water Department, *Chief Engineer's 1856 Annual Report*, (22 Jan 1857), 4; Water Department, *Chief Engineer's 1860 Annual Report*, (21 Feb 1861), 39; Water Department, *Chief Engineer's 1861 Annual Report,* (16 Jan 1862) 46.
[218] Water Department, *Chief Engineer's 1859 Annual Report,* (9 Feb 1860), 74.
[219] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 28.
[220] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 28; Water Department, *Chief Engineer's 1859 Annual Report*, (9 Feb 1860), 75. The Annual Report for 1858 states that the addition of the North Garden brought the total park acreage at Fairmount to thirty acres; the Annual Report for 1859 states thirty-two.
[221] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 28.

lower fountain, water flowed in sheets down a shallow, stepped channel into the river. The fountains were inaugurated on Independence Day, 1859.[222]

By this time the Wood Cliffside Stairs had become dangerously dilapidated. They were replaced in 1860 with two walkways terraced into the hillside—the Central and South Cliffside Paths—both leading to the crest of the reservoir. The switch-backed Central Cliffside Path led up from a point directly behind the Engine House, immediately to the south of the Wood Cliffside Stairs, and featured two dramatic Stone Arch Bridges across a tall cleft in the rock face.[223] Decorative iron railings were installed along the bridges in 1862.[224] During construction there were published complaints from members of the public who thought the scenic landscape of Fairmount was being needlessly defaced to provide inexpensive building materials, likely because some of the rock needed to be removed.[225] On the contrary, the public was reassured, the scenery would be enhanced while providing a more convenient way to ascend to the upper walkways.[226]

When the Central Cliffside Path was completed, the sculpture *Diana, The Huntress* was moved from its previous location just above the spring. Unfortunately missing a forearm due to vandalism, she was nevertheless carefully cleaned and placed on a pedestal at the foot of the new

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[222] Water Department, *Chief Engineer's 1859 Annual Report,* (9 Feb 1860), 74f; "Fairmount," clipping from unknown newspaper, (25 Apr 1859?), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131Col.2. Philadelphia Water Department Historical Archives, Accession 2004.071.001

[223] The cleft that the two arches bridged was the gap through which the ascending main from the Test Turbine (Wheel No. 9) rose from the lower level of the Engine House to Basin No. 1 of the Fairmount Reservoir. Only the lower Stone Arch Bridge survives today, the upper having been demolished during site preparation for construction of the Philadelphia Museum of Art in 1913 and 1914.

[224] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 33.

[225] "The Fairmount Water-works [*sic*]," *Public Ledger,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131-7; "Fairmount," *Philadelphia Inquirer,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131-4. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

[226] "The Improvements at Fairmount," *Public Ledger* (26 May 1859), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131Col.3; "The Fairmount Water Works—More Improvements," *Public Ledger* (18 Jul 1860), 141Col.3. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

path.[227]

The South Cliffside Path was a long and relatively straight incline beginning at the south end of the South Garden, near the Callowhill Street entrance at the eastern end of the Wire Bridge. Rising as it proceeded northward, at its upper end it met the Central Cliffside Path near that path's midpoint at about the level of the Mercury Pavilion.[228]

In 1856, Ogdin had recommended installing gas lighting on the grounds, partly in response to an uptick in crime, or "well known…abuses" as he put it, especially in the evenings.[229] Gas lights were not forthcoming,[230] but in 1858, in an effort to maintain public safety, Birkinbine arranged for a policeman to begin patrolling the grounds.[231]

One of Birkinbine's decisions aroused the ire of the general public. Sometime after he took office, he ordered the fountains on the grounds of Fairmount shut off on Sundays. Birkinbine should have known better. Although Philadelphia had a long history of so-called "blue laws," going so far as to chain off certain streets around houses of worship on Sunday mornings in order to discourage excess noise, it was always controversial. In fact, Robert T. Conrad, the city's first mayor after consolidation, failed in 1856 to win re-nomination during his first re-election campaign in part because of his aggressive enforcement of Sunday regulations.[232] After receiving indignant complaints, Councils' Committee on Water forced Birkinbine to turn the fountains back on.[233]

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[227] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 38f.
[228] Water Department, *Chief Engineer's 1855 Annual Report,* (17 Jan 1856), 4; Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 38.
[229] Water Department, *Chief Engineer's 1856 Annual Report,* (22 Jan 1857), 4.
[230] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 46. Birkinbine was still requesting gas lighting in 1862.
[231] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 28.
[232] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 369f.
[233] "Will Mr. Birkinbine Explain?" *Dispatch* (15 May 1859), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131Col.6; "Birkinbine Reproved," undated clipping of unknown newspaper, *Newspaper Clipping Scrapbook of*

After the controversy regarding the disappearance of materials from the yard of the Cherry Street workshop under Ogdin, Birkinbine began including in his reports an inventory of goods and work performed.[234] He also proposed enlarging the workshop and consolidating all Water Department workshop activities there in order to save on costs.[235]

Like Ogdin, Birkinbine recommended abandoning the Delaware Works and connecting its reservoir at 6th Street and Lehigh Avenue with the reservoir of the Schuylkill Works because of its operational costs and shortcomings as well as the polluted nature of the water it distributed.[236]

Birkinbine also renewed the call of his two immediate predecessors for the enlargement and consolidation of the Water Department offices.[237] Since 1854 the department had been spread across three locations.[238] The offices of the Chief Engineer and other officers were located at 918 Cherry Street. Those of the Register and his staff were housed in City Hall at 5th and Chestnut Streets next to the State House.[239] The Draftsman and his staff were quartered at Fairmount. In addition, water rent payments were accepted at the first two locations.

The workspaces were inadequate both individually and collectively. Customers paying water rents were poorly accommodated. The cramped and divided offices made running the department less efficient and more costly. The Department's clerks, for example, found it nearly

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Frederic Graff, Jr., 131Col.5; "Birkinbine Alarmed," *The Mercury* (17 Jun 1860), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137Col.3.

[234] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 29, and subsequent Annual Reports.

[235] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 28f

[236] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 105.

[237] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 107; Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 64f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 65.

[238] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 107; Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 71f.

[239] Known today as Independence Hall.

impossible to reorganize the records systems in the wake of the Consolidation. [240]

By 1860, silt deposits above Fairmount Dam had become a problem. The riverfront bluff in front of Lemon Hill had once plunged directly into the Schuylkill River approximately along the centerline of today's Kelly Drive, creating deep water along the east bank. In preparation for the construction of a freight depot serving the Schuylkill Navigation system, the rocky cliff had been partially excavated and the material used as fill to extend the shoreline up to two hundred feet farther out into the river. The depot project fell through almost before it began, but a skaters' club and rowing sheds—the beginnings of what became known as Boathouse Row[241]—were built in the area instead.

The extension of the shoreline and the shallowing of the river along the east bank created a zone protected by the river's strongest currents. These currents had previously served to scour the river bed and prevent silt from accumulating. Increasingly, steamboats operating from the wharves immediately above the Forebay on the east bank stirred up the silt which was then taken in by the pumps and deposited in the Fairmount and Corinthian Avenue Reservoirs, reducing their capacity, and affecting the quality of the water delivered to customers. Birkinbine recommended dredging the silt, demolishing the buildings which had been constructed, and restoring the shoreline as much as possible to its original configuration.[242]

In 1861 Birkinbine decried a growing problem, not just in the Water Department but across City government—the corruption of patronage. He complained that he was liable to lose re-election by Councils each July if he didn't appoint favored people—friends and other well-

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[240] This was finally addressed in 1863 when Councils arranged to rent space for adequate quarters for the entire department next to City Hall at the home of the American Philosophical Society below 5th and Chestnut Streets. See Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 71f.

[241] "Undine Barge Club," *Undine Barge Club (2016)*, <http://undine.com/wordpress/about-2/general-info-about-the-club/>, accessed 23 Aug 2016.

[242] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 13ff; Water Department, *Chief Engineer's 1861 Annual Report,* (16 Jan 1862), 5ff.

connected individuals—to various positions, no matter how unqualified they may be. He called for a system of merit-based hiring and continued employment contingent upon performance.[243]

At least one of Birkinbine's recommendations revealed a view beyond the immediate concerns of the water supply. He proposed converting a large spare lot on the property of the Corinthian Avenue Reservoir into "a parade or play ground." He explained:

> …there is a necessity for such open spaces, where the boys may enjoy those sports and plays necessary for physical development, without obstructing the streets, injuring the paths, grass, or statuary in the squares and works, or committing depredations upon private property. This would be a most admirable location for such a play-ground—central, easy of access, and at present of no other use to the City.[244]

By far, however, Birkinbine's greatest contribution while Chief Engineer was the expansion of the Fairmount Water Works.

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Graff, Jr. had warned that Fairmount was fast reaching its maximum capacity and Ogdin had recommended it be augmented. Birkinbine now determined that no matter how much the breast wheels might be improved, they were virtually at their maximum efficiency. The Schuylkill River had more to offer, but Fairmount's ability to "extract" power from it with its breast wheels had been topped out. In other words, there was additional waterpower and supply going to waste.[245]

In January 1859, Birkinbine evaluated the possibilities of procuring additional water from

[243] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 40f.
[244] Water Department, *Chief Engineer's 1861 Annual Report,* (16 Jan 1862), 53.
[245] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 4.

other sources, namely the Wissahickon Creek, the Schuylkill River above Reading, the Delaware River above Easton, and the Lehigh River. Determining that each of these possible sources had insurmountable problems, he concluded that the only alternative was to increase the pumping capacity at Fairmount. He recommended replacing Wheel No. 4 and its pump with a turbine and two new pumps. More significantly, he proposed installing two additional turbines in a second mill house purpose-built for them and situated along the eastern end of the Mound Dam at the northern edge of the current Mill House.[246] He reasoned that a new facility would need to be built because none of the current wheels could be spared to be taken offline while they were being replaced.[247] The only practical location for an additional facility was the Mound Dam.[248]

Birkinbine's proposed turbine facility would be sixty feet long and house two turbines with two pumps each.[249] Each turbine would produce approximately 100 hp, compared with the 35 to 40 hp produced by each of the breast wheels.[250] Together the three turbines, one in the Mill House and two in the new facility, would be able to pump 16,000 gallons per day during the portion of the year that received the most rain and at least 10,000 gallons per day during even the driest times.[251] He estimated that this new mill house would cost $50,000[252]—$15,000 for the building itself and $35,000 for the two turbines, four pumps, ancillary hardware, and discharge

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[246] *Report of the Chief Engineer of the Water Works, In Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,* addendum to Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 40, 45.
[247] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 89f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 48.
[248] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 40f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 48f.
[249] *Report of the Chief Engineer of the Water Works, In Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,* addendum to Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 45.
[250] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 5; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49.
[251] *Report of the Chief Engineer of the Water Works, In Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,* addendum to Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 40.
[252] The equivalent of approximately $1.8 million in 2022.

mains. He also estimated it would cost $14,000[253] to replace Wheel No. 4 and its pump with a turbine and two new pumps. The total estimated cost was $64,000.[254]

When City Councils recognized the urgency, Birkinbine changed his plans for the new facility. He abandoned the idea of replacing one of the breast wheels and its pump in the Mill House and decided instead to lengthen the new building to ninety feet and house all three turbines and their six pumps there.[255] Councils approved the new plan on 8 Apr 1859[256] and appropriated $52,000 for the project.[257] Construction began on time, early in the summer of the same year,[258] on the north or upstream side of the Mound Dam.[259]

Sometime after being given the go-ahead, Birkinbine again increased the length of the building, to 113 feet, probably realizing the need for greater internal space. Ninety feet wide, the New Mill House[260] was to be constructed of dressed cut stone and would accommodate three Jonval turbines which would drive two pumps each. Architecturally it was designed to fit in with the Old Mill House and be ornamental in its own right. A baluster rail around the flat roof would expand the promenade leading to the Eagle Pavilion.[261]

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[253] The equivalent of approximately $499,600 in 2022.
[254] *Report of the Chief Engineer of the Water Works, In Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,* addendum to Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 45. The amount was equivalent of approximately $2.3 million in 2022.
[255] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 90.
[256] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 46.
[257] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 80. The amount was the equivalent of approximately $1.9 million in 2022.
[258] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 45; Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 100. In the Annual Report for 1858 Birkinbine projected a start time of early summer 1859; the Annual Report for 1859 shows this projection was met.
[259] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49.
[260] The new turbine facility was first called the "new mill house" in the Annual Report for 1859. The original Mill House began to be called the "old Mill House" and "old mill house," in order to distinguish it, in the Annual Report for 1860. Official published sources used various forms of capitalization and hyphenation for a time (e.g.—mill-house) before settling generally on the convention which is used throughout this work—New Mill House and Old Mill House. See for example Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 100; Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), iv ("Table of Contents"), 74, 89; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), iv ("Table of Contents"), 47, 54.
[261] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), Plate 1.

Since the structure would straddle the Mound Dam, the work to build it would need to be carefully planned and executed in order to safeguard the integrity of Fairmount Dam. The slackwater pool held back by the Fairmount Dam system was the source of virtually all of the water the City of Philadelphia depended upon, in addition to the foundation of the business prospects of the Schuylkill Navigation system. It was much more than just a challenging engineering exercise.

Construction was started by sinking a cofferdam in the water just beyond the north edge of the Mound Dam. Behind the cofferdam, the water was pumped out and the foundation for the northern portion of the New Mill House was begun. Workers excavated a trench and laid a bed of crushed rock. White pine logs, twelve inches wide, were placed atop the crushed rock. Permanent sheet piling was driven down on either side of the rock and pine. The spaces between the pine logs were filled with crushed stone bound with grout consisting of cement and gravel. All of this was covered in three-inch pine planks. Atop this foundation the north wall of the New Mill House was erected. Penetrating the wall were three head arches and gates, one for each turbine's head race and flume.[262]

While construction was in progress on the north side of the New Mill House, the Schuylkill Navigation Company objected to the project, asserting that the work created an unacceptable risk to the continued operation of the canal upon which the fortunes of the company rested.[263] A breach in the Mound Dam during construction could result in a catastrophic failure of the Fairmount Dam system. Should this occur, the resulting loss of water

[262] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49f.
[263] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 100; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49.

above the dam would have devastating consequences for the company.[264]

Birkinbine allowed the canal company's board of managers to examine the construction plans which demonstrated that the New Mill House was being built almost entirely around the Mound Dam, not in it or in place of it. This was being accomplished by constructing most of it on the downstream side of the Mound Dam; only the three head races channeling water from the Forebay to the flumes of the turbines would pass through the Mound Dam itself.[265]

The canal company's managers' fears were assuaged enough that they withdrew their objection to the project. Perhaps out of distrust of Birkinbine's ability or willingness to stick to the plans they were shown, however, the managers nevertheless demanded the Water Department obtain their formal permission before continuing. The City refused and the canal company brought suit in court.

Although the court nominally decided in the canal company's favor, it was in fact a victory for the City. The court did not prohibit the project or even temporarily stop work on it but perhaps acknowledging Birkinbine's tendency to change or expand a project while part of the way through, it did direct the Water Department to proceed strictly in accordance with the plans that were presented.[266]

Construction on the south side of the new facility[267] did not begin until the north side work was completed and the Mound Dam secure. It was also delayed until the canal company's legal action was resolved. As with its counterpart, the first step was to drop a cofferdam. Unlike

[264] Not to mention the catastrophe to virtually the entire population of the City of Philadelphia if its source of water—the Schuylkill River—were put out of reach in a single stroke. This possibility may truly have been appalling to the managers of the Schuylkill Navigation Company, but it was not the basis for their legal action.
[265] Each of the three masonry head races penetrated the Mound Dam and led to a cast iron flume which was located on the south side of the Mound Dam and delivered water directly to a turbine.
[266] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 100; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49.
[267] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 87f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49f.

the relatively shallow and narrow foundation on the north side, however, the one on the south needed to be much deeper and wider to accommodate the turbine pits. It would be 23 feet wide and run the length of the building, 113 feet. The top of the foundation, forming the floor of the turbine pits, would be four feet, four inches below mean low tide and ten feet, four inches below mean high tide. Each of the three turbine pits would measure fifteen by twenty feet.[268]

Behind the cofferdam, material was excavated down to fourteen feet below mean high tide. Preconstruction soundings had indicated there would be bedrock beneath a moderate layer of mud. Instead, there turned out to be a thin layer of mud, beneath which was a layer of gravel between three and five feet thick covering a lower level of river mud seventeen feet thick, all of which bottomed out at bedrock 23 feet down.[269] The unexpected conditions meant that construction would take longer than was projected.

In order to provide a stable foundation for the turbines, 350 piles were driven through the gravel and mud to the bedrock. Around the heads of the piles, the mud was excavated eighteen inches down and backfilled with crushed rock. Twelve-inch timbers were laid across the heads of the piles and a double row of sheet piling was driven on either side of the platform. As with the north side, the spaces between the timbers were filled with crushed stone held together with cement-and-gravel grout.

Although the turbines were to be situated in front of the south side of the Mound Dam, the pumps would be located partly atop the structure but their foundations did not need to be nearly as deep. The gravel of the Mound Dam was partially excavated, leveled, and grouted. In order to provide a stable platform and ensure the integrity of the Mound Dam, 33,500 cubic feet

[268] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 45.
[269] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 87f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 50.

of grout was used to bind the material together.

On the south side, the greater depth of the work and the unanticipated conditions which were encountered weren't the only problems. Large amounts of water constantly infiltrated through the gravel of the Mound Dam and around the cofferdam, especially at high tide. Repeated freshets didn't help.[270] Additional pumping machinery was brought in and eventually four steam pumps were operating 24 hours a day, moving up to one hundred barrels of water per minute. Of course, this meant further delay.

The difficulties and delays meant increasing costs. When Birkinbine first proposed the new work in January 1859, he had estimated the project would cost $50,000,[271] but that was for a smaller, less capable facility. The one actually planned was a third larger by the time City Councils appropriate $52,000[272] toward it in April of 1859. Councils certainly knew the completed project would cost more than that; the initial amount was likely considered a first installment of sorts. Indeed, another $41,000[273] was appropriated in July 1860, $23,000 for the building and $17,500 for the turbines and associated hardware. This brought the total amount set aside at that time to $93,000.[274]

Nevertheless, when Birkinbine had spent $53,683 by the end of 1860, and with construction underway for year and a half with no end in sight, City Councils' Committee on Water called him on the carpet to explain. Because of the difficulties and delays, Birkinbine had been shifting moneys around between various internal funds until to the outside observer it looked like a hopeless muddle. The committee was apparently concerned that he might be letting

[270] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 102; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 99.
[271] The equivalent of approximately $1.8 million in 2022.
[272] The equivalent of approximately $1.9 million in 2022.
[273] The equivalent of approximately $1.5 million in 2022.
[274] The equivalent of approximately $3.4 million in 2022.

the finances get away from him and appointed a three-member subcommittee to investigate.[275] On 22 December, in what was likely a rather strained meeting, the subcommittee posed a number of pointed questions.[276] Birkinbine was forced to provide a detailed accounting of every penny and justify the reasons for the delay and increased cost.

On 22 Jan 1861 Birkinbine provided a thorough financial report. He also detailed the reasons for the increase in costs. They boiled down to: expansion of the initial plans, ensuring the safety of the Mound Dam, over-engineering the facility for long-term cost-effectiveness, unexpected delays in construction, and the lengthy process of selecting a turbine contractor.[277]

Birkinbine had at first proposed a sixty-foot-long facility housing only two turbines and four pumps. This had been changed to a ninety-foot-long building for three turbines and six pumps by the time Councils gave approval for the project and appropriated funds for its construction, but Birkinbine was reminding anyone who may have forgotten. At any rate, it had now grown to a length of 113 feet,[278] most likely to provide sufficient room for the turbines and pumps.

Because of its position over the Mound Dam, Birkinbine over-engineered the New Mill House in order to provide a large margin of operational safety.[279] Not only the building, but the construction methods as well were carefully planned to minimize risk to the Fairmount Dam system.[280]

Birkinbine also designed the building for durability, constructing it of dressed cut stone.

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[275] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 78ff.
[276] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 79.
[277] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 79ff.
[278] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 79.
[279] See also Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 102
[280] In his reports, Birkinbine repeatedly emphasized the critical importance of protecting the Mound Dam. See for example Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 88f; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 49.

Instead of wood head gates, Birkinbine installed iron faced with brass. Three wood head gates would have cost $1,200[281] altogether but would need to be replaced every fifteen years or so; the set of iron gates cost $2,500[282] but were projected to never need replacing. Virtually all woodwork and other perishable materials, in fact, were eliminated.[283]

Perhaps the most innovative portion of the building in this regard was its roof. Initially to be a typical timber design, Birkinbine instead chose to employ what were early examples of iron I-beams. The beams were spaced with brick barrel vaulting and supported by cast-iron columns. The roof's flat exterior, which would necessarily re-form the promenade atop the Mound Dam, was to be paved with flagstones.[284] The roof alone was responsible for $8,000 of the cost overrun.[285]

The suit brought by the Schuylkill Navigation Company, the unanticipated subsurface conditions, and constant water infiltration all contributed to construction delays and higher costs. As of February 1861, however, the masonry wall on the south side of the New Mill House had risen above the high water mark and Birkinbine projected completion of the building in three months.[286] He also estimated that the total cost would come in at $123,500.[287]

There was one bright spot in the expansion project, a portion which was completed on time and just barely over budget. Recall that the discharge and ascending mains from the Old Mill House had fed directly into the Fairmount Reservoir. When the Corinthian Avenue

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281 The equivalent of approximately $40,400 in 2022.
282 The equivalent of approximately $84,100 in 2022.
283 Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 90f.
284 Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 79; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 50.
285 Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 79. The amount was the equivalent of approximately $269,200 million in 2022.
286 Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 75.
287 Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 91. The amount was the equivalent of approximately $4.2 million in 2022.

Reservoir was built, one mile distant and 16 feet higher in elevation than the Fairmount Reservoir, the Standpipe was erected as a means of "assisting" the delivery of water to Corinthian Avenue. The ascending mains from the Old Mill House were connected to the base of the Standpipe in such a way that the water could be directed to either the Fairmount Reservoir or Corinthian Avenue Reservoir as requirements may demand. The New Mill House would need to connect to this system so that its water could do the same.

Birkinbine's solution was something which came to be called the Distribution Arch. Constructed to the north of the Standpipe, it was designed to serve as a connection node to receive water from the New Mill House and direct it to either of the two reservoirs, much like what the taper pipe and valve system at the base of the Standpipe did for the Old Mill House. Water from the Old Mill House would reach the Distribution Arch via a connection near its top. Three discharge mains from the New Mill House, one from each turbine, would connect at the bottom. The thirty-inch main to the Corinthian Avenue Reservoir, originally connecting directly with the base of the Standpipe, would be reconnected via a group of stopcocks near the top of the Distribution Arch. A connection for a future 48-inch main to the Corinthian Avenue Reservoir would be provided near the base.

The Distribution Arch was shaped like an enormous inverted L jutting out of the northwest corner of the Fairmount hillside. Its exterior was fashioned of stone masonry; like the Standpipe, its functional components were concealed from view. Within the vertical portion was a 5-foot-diameter, 64-foot-high wrought iron pipe, closed at the top. Seven feet from the top of the vertical pipe, a 36-inch-diameter pipe branched off and ran horizontally through the interior of the horizontal portion, then below ground near the top of the hillside to the Standpipe. The seven feet at the top of the vertical pipe above the horizontal branch was filled with air and

served the same function as the air vessels located near the pumps—to moderate pressure spikes (water hammer) in the system.[288]

The length of the horizontal pipe connecting the upper portion of the Distribution Arch to the base of the 4-foot-diameter pipe within the Standpipe is not precisely known, but analysis of historical photographs suggests it was approximately 120 feet. Along the horizontal pipe, between the Distribution Arch and the Standpipe, was a group of stopcocks to which the 30-inch main to the Corinthian Avenue Reservoir was reconnected.[289] The iron pipe within the Distribution Arch weighed a total of 14 tons.[290]

The exterior of the Distribution Arch was faced with 4,655 square feet of dressed brownstone and 4,425 square feet of gneiss. The fenestrations (window penetrations) were trimmed with flagstone and the arch beneath the horizontal portion was constructed of 7,500 bricks.[291] Construction of the structure required the excavation of 640 cubic yards of rock and earth from the Fairmount hillside. The three discharge mains leading from the New Mill House to the base of the Distribution Arch were hidden within the Forebay Bridge, requiring the excavation of 233 cubic yards of material from beneath the deck.[292]

A steep, switch-backed walkway, eventually known as the North Cliffside Path, was carved into the hillside. It passed through the archway of the Distribution Arch and led up to the walkway around the reservoir. From this walkway, visitors could access a balustraded overlook atop the structure.[293] In addition to its functionality, Birkinbine designed the Distribution Arch to

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[288] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 52.
[289] Frederick Graff, Jr., *Notebooks*, c.1872. Philadelphia Water Department Historic Archives, Accession 2004.062.003.
[290] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 55.
[291] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 56.
[292] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 55.
[293] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 52.

be ornamental.[294] Jutting out from the corner Fairmount like the prow of a great ship, it was a dramatic, picturesque addition to the constellation of structures at Fairmount and quickly became popular with photographers.

Councils had designated $13,000 for the Distribution Arch[295] on 18 Jul 1860, in its second expansion appropriation.[296] Construction was begun and completed in 1861 at a cost of $13,628, less than five percent over budget.[297] Within its cornerstone was placed a time capsule containing a message from the mayor, the Chief Engineer's most recent annual report, copies of local newspapers, and the names of 54 Water Department employees who were then fighting for the Union in the Civil War.[298]

In 1859, while plans for the construction of the New Mill House were well underway, the decision had not yet been made as to the type of turbine to install in the new building. Birkinbine was initially reluctant to engage in a design competition. He thought such an endeavor would take too much time and delay final design and construction. It was also difficult obtaining precision data from scale models.[299] Councils insisted, however, and appropriated $500 for the effort.[300] Birkinbine didn't think it was enough, but proceeded anyway.[301] The Water Department published a notice of the competition in the 4 Jun 1859 edition of *Scientific American*[302] and sent a description of specifications and requirements to anyone who inquired.[303]

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[294] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 52.
[295] The equivalent of approximately $463,900 in 2022.
[296] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 80.
[297] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 74.
[298] "Corner Stone Laid," undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.*, 140. Philadelphia Water Department Historical Archives, Accession 2004.071.001. Unfortunately, there is no record of the time capsule having been recovered when the Distribution Arch was demolished in 1920.
[299] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 3, 48.
[300] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 47, 52. The amount was the equivalent of approximately $17,800 in 2022.
[301] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 48.
[302] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 53.
[303] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 53.

A test rig was constructed to evaluate submissions. It stood on the floor of the Esplanade and rose up and over the fifteen-foot retaining wall, onto the deck of the South Garden.[304] With the apparatus, all of the turbine models were evaluated for efficiency. Trials recorded the time it took for a designated amount of water to pass through each turbine. They were tested under various loads and at different running velocities. A head of six feet was employed, matching the minimum at Fairmount.[305] In designing and building the test rig and conducting the evaluations, the Water Department received assistance[306] from James Millholland, the renowned master machinist from the Philadelphia & Reading Railroad,[307] William B. Bement, a prominent machine tool manufacturer in Philadelphia,[308] Charles S. Close, a mechanic,[309] and Oliver H. P. Parker, Select Councilman from the 6th Ward and Chairman of the Committee on Water.[310]

The evaluations were begun in October 1859[311] and continued into early 1860. Participants arrived from as far away as Texas.[312] Some models performed poorly and were eliminated from the competition before completing their tests; these were not included in the tabulated results. Nineteen turbines from twelve manufacturers were successfully tested. A total of 122 individual trials were run. More submissions could have been tested but the funds ran out

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304 Water Department, *Report on the Experiments with Turbine Wheels* (1861), Plate 2. To some, the diagram of the test rig looks rather like a cross between an Escher print and a Rube Goldberg drawing.
305 Water Department, *Report on the Experiments with Turbine Wheels* (1861), 4, 48.
306 Water Department, *Report on the Experiments with Turbine Wheels* (1861), 5f, 48.
307 "Death of James Millholland, Esq.," *Reading Times* (19 Aug 1875), 1, <www.newspapers.com/clip/3617357/obituary_of_james_millholland/>, accessed 4 Aug 2019.
308 "William Barnes Bement," *Find a Grave* (14 Feb 2013), <www.findagrave.com/memorial/105216488/william-barnes-bement>, accessed 4 Aug 2019.
309 Stephanie A. Morris, Ed., *The Franklin Institute and the Making of Industrial America: Guide to the Microfiche Collection* (Bethesda, Maryland: Congressional Information Service, 1987), 12n.23.
310 *Journal of the Select Council of the City of Philadelphia* (Philadelphia: Chrissy & Markley 1858), 3f, 40.
311 "The Fairmount Water Works—More Improvements," *Public Ledger* (18 Jul 1860), 141col.3. Philadelphia Water Department Historical Archives, Accession 2004.071.001.
312 "The Trial of Turbine Wheels—Interesting Experiments," undated clipping of unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 131col.1; "The New Mill-House at Fairmount and the Turbine Water Wheels," *Sunday Dispatch,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.6. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

and Birkinbine was unwilling to delay the final design of the New Mill House any further.[313]

All of the highest scoring models were axial designs, venting water vertically. In performance these were followed by centrifugal lateral designs which vented water to the side. Centripetal turbines, which vented water toward the center, scored the poorest.[314]

Of the models tested, three stood out. From the top, they were the second submission from J. E. Stephenson of Paterson, New Jersey, the second submission from Emile Geyelin of Philadelphia, and the third submission from the partnership of Andrews & Kalbach of Bernville, Pennsylvania. The highest efficiency achieved by Stevenson's model was 87.77 percent,[315] the highest by Geyelin's was 82.10 percent,[316] and the highest by Andrews & Kalbach was 81.97 percent.[317] At the direction of the Committee on Water, Birkinbine on 10 Apr 1860 sent a request for quotes for three full-scale turbines and associated gearing to each of the three manufacturers, as well as to Levi Smith of Reading, Pennsylvania, whose Parker turbine, although only the sixth highest performer, was the best of the centrifugal lateral designs.[318]

Three returned bids; they were opened on 24 Apr. At $23,400[319] ($6,900 for the turbines themselves and $16,500 for the gearing and other equipment), Geyelin was the low bidder. Smith submitted a bid for $25,470[320] ($12,390 for the turbines and $13,080 for the gearing). Stevenson's bid came in at $29,500[321] ($15,000 for the turbines and $14,500 for the gearing).[322]

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[313] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 3, 48.
[314] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 5, 41.
[315] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 20, 40, Table 21 at 42, Exhibit D at 54.
[316] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 12, 40, Table 21 at 42, Exhibit D at 54.
[317] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 24, 40, Table 21 at 42, Exhibit D at 54.
[318] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 51, 55.
[319] The equivalent of approximately $835,000 in 2022.
[320] The equivalent of approximately $908,800 in 2022.
[321] The equivalent of approximately $1.1 million in 2022.
[322] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 51.

Birkinbine determined that Geyelin should be awarded the contract.[323]

Although he had his defenders,[324] the Chief Engineer was accused in the local newspapers of unduly favoring a local manufacturer.[325] Some claimed the greater efficiency of Stevenson's turbine would pay for the difference in cost in just a few years.[326]

Birkinbine provided a thorough justification for his decision. He had been careful to avoid conveying the idea that the best performing model turbine would automatically be selected for full-scale installation.[327] Indeed, the invitation he sent out in July 1859 specifically stated that the purpose of the evaluation was to identify the model "that will be best adapted (all things considered,) for" the operating conditions at Fairmount.[328] A careful read of Birkinbine's report shows that performance was only one of three major factors which were considered.[329] The second was cost. The performance of Geyelin's model turbine may have been second best, but Geyelin's bid was the lowest.

The third factor—risk—was perhaps most important of all. Stevenson had no experience with large, full-scale turbines.[330] Geyelin had several operational turbines, up to 200 horsepower, to his credit,[331] including of course the one which had been operating so successfully between the

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[323] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 52.

[324] M. R. Moore, "The Philadelphia and New York Water Works," undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 142col.2; *Sunday Dispatch,* undated clipping, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

[325] "Trial of the Water-Wheels," *Public Ledger* (6 Jan 1860), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.3; *Public Ledger,* undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.1. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

[326] "The New Mill-House at Fairmount and the Turbine Water Wheels," *Sunday Dispatch*, undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.6. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

[327] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 4, 52.

[328] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 53.

[329] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 5, 49ff.

[330] Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 142col.1f. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

[331] "Obituary: Emile C. Geyelin," *Proceedings of the Engineers' Club of Philadelphia,* Vol. XVIII, No. 1 (Feb 1901), 68f; Undated clipping from unknown newspaper, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 142col.1f. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

Engine House and the Old Mill House continuously for the previous nine years. With no repairs necessary to the turbine itself in all that time, the Water Department was well aware of the durability of Geyelin's designs.[332] Simply put, Geyelin's turbine represented far less risk than Stevenson's.

The decision was made on the basis of performance, cost, and risk—not performance alone.[333] There was nothing unethical about it. Stevenson appealed to City Councils, but the Committee on Water confirmed Birkinbine's judgment.[334]

By 7 Jun 1860, the Water Department had awarded Geyelin the contract for the first two turbines and gearing. Eventually he would be awarded the contract for the third turbine as well. Geyelin selected the highly respected I. P. Morris foundry, located in the Port Richmond neighborhood of Philadelphia, to fabricate them.[335]

In the meantime, the slow progress of construction on the New Mill House continued. Recall that at the end of 1860, $93,000 had been appropriated by Councils. Birkinbine had spent roughly $54,000 of that and was projecting completion by the end of May 1861 with a total cost of $123,500.

Birkinbine's optimism was misplaced. May of 1861 came and went without the New Mill House being completed. It still wasn't completed at the end of the year. Spending $57,219 that year, $13,535 for the building and $46,165 for the turbines and pumps, brought the total so far to

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[332] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 50.
[333] Birkinbine also published a succinct summary of his rationale in the *Journal of the Franklin Institute*. See Birkinbine to Geyelin, 5 Apr 1961, *Journal of the Franklin Institute,* Vol. 71, Issue 5 (May 1861), 350.
[334] *Public Ledger*, undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.1. Philadelphia Water Department Historical Archives, Accession 2004.071.001.
[335] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 269.

$110,902.[336] In mid-January of 1862, Birkinbine fixed the blame for the latest delay squarely on an unnamed middleman the Committee on Water had insisted upon hiring to contract out the manufacturing of the pumps and associated machinery. Birkinbine considered the person unqualified and unnecessary. He pointed out that the middleman was contracted to have his work finished no later than October of 1861, but because of his incompetence the project was five months behind where it should be. Still, Birkinbine figured he could get it done by April.[337]

Curiously, Birkinbine did not in any of his reports attribute any delay to an accident which occurred at the I. P. Morris foundry where the turbines were being manufactured, even though it must have set production back at least somewhat. At the end of the work shift on Saturday 19 Oct 1861, one of the shop engineers and two other men stayed behind after all of the other employees had left, in order to clean out three boilers. Just before six o'clock in the evening, as the three were extinguishing the fires, one of the boilers exploded.

The force of the explosion blew one fifteen-foot portion of the boiler, weighing a ton, 150 feet through four nine-inch-thick walls, destroying two stationary steam engines and demolishing the contents of the brass foundry as it went. A 360-pound portion of the boiler was flung 150 feet in another direction. A horse-driven passenger street car[338] passing along nearby Richmond Street was showered in bricks. The plant's steam whistle was found two hundred yards away.

One portion of the boiler was propelled through a wall into the iron foundry where the casing for one of the turbines was being fabricated. It struck the two-inch-thick casing and smashed it to pieces, instantly turning it into scrap iron.

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[336] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 74. The amount was the equivalent of approximately $3.7 million in 2022. Inflationary changes to the value of the dollar since the start of construction makes it a very rough approximation.
[337] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 47.
[338] Horse cars running on rails had begun to replace omnibuses in Philadelphia in 1858. From that year to 1864 the number of omnibuses declined from 322 to just one. See Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 379.

The engineer was killed immediately, partially decapitated by flying debris. The other two men were scalded by the steam, one so severely he died a little over three hours later. The engineer left behind a wife and nine children, two of which were married adults. The other man left a wife and two children. It was fortunate that Morris paid its employees immediately after the day shift on Fridays; if the company had followed the practice of most others of its type and paid its employees after work on Saturdays, there most likely would have been a greater loss of life.[339]

The New Mill House was finally completed and its three turbines and six pumps began operating in June 1862.[340] From the outer Forebay on the north side of the Mound Dam, water passed beneath one of three head gates, each of which was raised and lowered by a hand crank. After passing the gate, the water flowed along a masonry head race which penetrated the Mound Dam and delivered the water to its south side. From the head race, the water flowed through a wrought iron flume which was twelve feet, ten inches wide by seven feet, two inches high and had a 70-square-foot elliptical cross section. The head race and flume had a combined length of 65 feet. From the flume, the water entered the turbine from above.[341]

Each of the three turbines was much like Wheel No. 9, the so-called “Test Turbine” which had been operating between the Engine House and Old Mill House, but at seventeen feet high were somewhat larger. From a slightly domed chamber directly above the turbine, the water fell down and through the stationary wheel. This wheel was twelve feet in diameter and one foot, seven inches high. The stationary wheel had seventeen curved guide vanes which moved the

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[339] “Boiler Explosion at Richmond: Serious Accident, Two Men Killed,” *Philadelphia Inquirer* (Monday, 21 Oct 1861), 8.
[340] Water Department, *Chief Engineer’s 1862 Annual Report* (5 Feb 1863), 14.
[341] “Turbines at the Philadelphia Water Works, 27 Apr 1866,” *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 269.

water in a clockwise direction as it fell onto the movable wheel beneath.[342]

The movable wheel was nine feet in diameter and one foot high. It had fifty vanes or "buckets" 2 feet, 8 inches wide, arranged around the outside rim of the wheel. The weight and direction of the flow of the water, in combination with the curve of the wheel's vanes caused the wheel to move in a clockwise direction at approximately 35 rotations per minute (rpm). Both of the wheels were constructed with smooth-ground wrought iron vanes arranged around a cast iron center and bound by a wrought iron rim.[343]

After passing through the movable wheel, the water passed through a Parker draft tube, at the bottom of the turbine's casing, and out the tail race. The draft tube created a siphon effect and increased the efficiency of the turbine. This device also allowed the turbine to operate, if need be, while completely submerged by floodwaters.

Enclosing the space directly beneath the draft tube was a cylindrical exit gate, 10 feet, 5 inches in diameter and 2½ feet high; it could be raised (opened) and lowered (closed) from above by gearing. After falling through the draft tube, the water passed through the exit gate in all directions. Now at the bottom of the wheel pit, it flowed out through the tail race into the river.[344]

The movable wheel was keyed to an eight-inch-diameter cast iron shaft which rotated upon a bearing of lignum vitae.[345] The shaft passed through the top of the turbine casing and

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[342] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 269.

[343] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 270. The movable wheel of each of the turbines in the New Mill House was 65% larger in area than the seven-foot-diameter Test Turbine (Wheel No. 9) operating between the Engine House and Old Mill House.

[344] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 270.

[345] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 270. Lignum vitae is a dense, durable, and self-lubricating wood. Grown in the Caribbean, it is the densest commercially available wood and sinks in water. Scarce for a time, it is once again commonly used for hydraulic turbine bearings and other applications. Since 2013, for example, it has been used for the main bearings in the turbines of the Conowingo Hydroelectric Dam on the Susquehanna River, 55 miles to the southwest of Fairmount, one of the major generators of electricity for the greater Philadelphia region. See "Lignum Vitae," *Lignum Vitae*

drove a set of bevel gears which turned the rotational motion ninety degrees from vertical to horizontal. The horizontal shaft drove two geared crank wheels, one on either side of the turbine, each of which drove a crank rod connected to the piston of a pump. The gearing reduced the movement at the crank wheels to twelve rpm. All of the gears were cast iron with teeth made of dressed hickory.

Each pump was double-acting, drawing water from two openings in the side of each flume with the movement of the piston in each direction, twelve cycles or 24 motions of the piston per minute. Each piston was eighteen inches in diameter and had a six-foot stroke. The six pumps together had a capacity of 16 million gallons per day.[346]

Each pair of pumps pushed water through a single 30-inch-diameter discharge main. From the New Mill House, the three 30-inch discharge mains crossed the Forebay horizontally, hidden within the Forebay Bridge just below its deck and above its arches. After crossing the Forebay, the three discharge mains connected below ground to the side of a relatively short, horizontal length of 48-inch main which protruded from the north end of the Distribution Arch below ground.[347] The other end of this short 48-inch main was a stub-end which provided for the future connection of a 48-inch main directly from the New Mill House to the Corinthian Avenue Reservoir.

From the Distribution Arch the water could be directed to either the Corinthian Avenue Reservoir via the 30-inch main which branched off between the Distribution Arch and the

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Wood Bearings (2020), <https://lignumvitaesolutions.com/>, accessed 27 Jun 2020; Lignum Vitae Supplies Bearings for 575-MW Conowingo Hydropower Project," *Hydro Review* (7 Aug 2013), <https://www.hydroreview.com/2013/08/07/lignum-vitae-supplies-bearings-for-575-mw-conowingo-hydropower-project/>, accessed 27 Jun 2020.

[346] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862 1869), 51; Water Department, *Report Upon the Extension of the Water Works* (31 Mar 1864), 1.

[347] Frederick Graff, Jr., *Notebooks*, c.1872. Philadelphia Water Department Historic Archives, Accession 2004.062.003.

Standpipe, or to the Fairmount Reservoir via the connecting pipes on the south side of the Standpipe. The stopcocks located between the Distribution Arch and Standpipe were used to control the direction of the flow.[348]

With a total expenditure of $40,724 during 1862,[349] the overall cost of the New Mill House topped out at $151,626.[350] When the cost of the Distribution Arch was included, the grand total came to $165,254.[351]

The cost overrun provoked a good deal of controversy. Birkinbine was accused in the press of deliberately low-balling his pre-construction estimates. He was called incompetent and erratic. His defeat was urged in Council's next election of department heads and other city officials.[352]

Was Birkinbine intentionally deceptive? On the one hand, year after year, all of Birkinbine's estimates turned out to be below actual costs, most by significant margins. Construction difficulties don't seem to explain everything. He had a habit of replacing more durable, and accordingly more expensive, materials for those initially planned. This was part of his explanation of the cost increases in January 1861, but he continued this practice as the project

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348 Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 50ff; "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 269f.

349 The equivalent of approximately $1.2 million in 2022.

350 Water Department, *Report Upon the Extension of the Water Works* (31 Mar 1864), 2. See also Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 11, 46f, 71f. Birkinbine reported a total expenditure of $353,064 for "all these improvements." The amount spent on the New Mill House and turbines alone is revealed when the expenditures for the Distribution Arch, Corinthian Avenue Reservoir improvement, and 30-inch main from that reservoir to the 1st Ward are subtracted. The amount was the equivalent of approximately $4.4 million in 2022. Inflationary changes to the value of the dollar since the start of construction makes it a very rough approximation.

351 The equivalent of approximately $4.8 million in 2022.

352 "Water Department," *The Press* (23 Feb 1860), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.5; "Failed," *Sunday Dispatch* (18 Mar 1860), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 142col.4; "An Admonition for the Future," *Sunday Transcript* (23 Sep 1860), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 148col.3; "Local Affairs: The New Mill House at Fairmount," *Ledger and Transcript* (Saturday, 16 Feb 1861), *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 143col.7; "Birkinbine," Dispatch, undated, *Newspaper Clipping Scrapbook of Frederic Graff, Jr.,* 137col.7. Philadelphia Water Department Historical Archives, Accession 2004.071.001.

progressed. In 1862, for example, he recommended that the aging and dilapidated wood railing along the Forebay Bridge be replaced with a stone balustrade. He also recommended extending it around the perimeter of the deck of the New Mill House,[353] but it seems he didn't wait for approval or appropriation but simply included all of it in the construction. In addition, he failed to include a large portion of the project, the Distribution Arch, in his cost estimate for the New Mill House even though it was a necessary and integral part of the system.

On the other hand, Councils had to have recognized that the initial appropriation of $52,000 in 1859 would not cover everything, that it was merely a first installment or down payment of sorts. Recall that in Birkinbine's initial proposal, in January 1859, he included the replacement of one of the breast wheels in the Old Mill House with a turbine and two pumps, in addition to the construction of a New Mill House with two turbines and four pumps. This meant that the total initial project cost estimate was $64,000,[354] not just the $50,000 for a new standalone facility. That's still a long way, of course, from the eventual total of $165,000, or even $151,000 if one doesn't count the Distribution Arch.

Discounting the cost of the Distribution Arch and the proposed replacement of one of the breast wheels in the Old Mill House, the eventual cost of the New Mill House by itself was over triple the initial projected cost. Still, the unforeseen construction difficulties were immense for the period and the protracted delays greatly increased costs, especially for labor in that time before powered tools and heavy-lift machinery. Through the end of 1861, wages accounted for a staggering 67.6 percent of the cost of constructing the building.[355]

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[353] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 46.
[354] *Report of the Chief Engineer of the Water Works, In Relation to a Better Supply of Water for the Accommodation and Convenience of the Citizens of Philadelphia,* addendum to Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 45.
[355] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 72f.

Was Birkinbine duplicitous? Did he intentionally lowball his estimates, perhaps out of fear that Councils would not approve something he considered to be crucial to the future of the City of Philadelphia? Unless a journal or diary of some sort is discovered, in which Birkinbine confided to himself or a close associate, we likely will never know for sure.

One thing is certain. Birkinbine built the New Mill House to last. When rainfall from the Saxby Gale Hurricane, Hurricane Diane, Hurricane Agnes, and Hurricane Ida caused Schuylkill River to rise to 17, 14.32, 14.65, and 16.35 feet above the crest of Fairmount Dam in 1869, 1955, 1972, and 2021 respectively,[356] the building never budged.

Either way, it seems the members of Councils grew weary of it all. In July 1862, just a month after operational testing of the New Mill House turbines began, Councils elected Isaac S. Cassin to replace Birkinbine.[357] A hydraulic engineer, Cassin had been serving as chief engineer of the Schuylkill Works, having replaced Samuel Ogdin when Councils elected the latter Chief Engineer of the Water Department in 1856.[358]

Cassin immediately recognized the need to increase Fairmount's output and took up the call to replace the breast wheels in the Old Mill House with turbines.[359]

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356 U.S. Geological Survey and National Oceanic and Atmospheric Administration, *Hurricane Agnes Rainfall and Floods, June–July 1972/Geological Survey Professional Paper 924* (Washington, D.C.: 1975), 99; Anthony R. Wood, "The Schuylkill Flood That Outdid Ida's Wrath," *Philadelphia Inquirer* (4 Oct 2021), B1, B4; National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 14 Jan 2020); National Weather Service, *Categorical Floods: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 15 Jan 2020); National Weather Service, *Historical Floods: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 21 Jan 2020); "Schuylkill River at Philadelphia, PA," *U.S. Geological Survey* (2021), <https://waterdata.usgs.gov/monitoring-location/01474500/#parameterCode=00065&period=P365D&compare=true>, accessed 16 Dec 2021.

357 Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 2, 88, 100.

358 "Obituary: Isaac S. Cassin," *The Iron Age* (11 Mar 1897), 17.

359 Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 9ff.

CHAPTER 7

RECONSTRUCTION OF THE OLD MILL HOUSE

As we have seen, Philadelphia's consolidation in 1854 had a profound effect upon virtually every aspect of life in the city and surrounding areas, including the managing of the Water Department and the Fairmount Water Works. It wrought lasting structural changes in the way the city was governed in the nineteenth century.

Around the same time, a second factor, this one social and cultural, had a significant influence as well. As the city moved from an artisan- and merchant-based economy to an industrial one, large numbers of immigrants began to swell the population. By the 1850s, nearly a third of Philadelphia's residents were foreign-born (mostly Irish and Germans), the second largest percentage among American cities,[1] and the city's black population was four percent of the total, small by today's standard but the largest of any northern city at the time.[2] Both groups were treated as outsiders. Increasingly, Philadelphia's citizens felt less loyalty to a patrician elite and more to party-based career politicians.[3]

One of the results of this third factor was the reduction of the influence of men of standing—successful, wealthy businessmen, industrialists, and entrepreneurs, generally from longstanding families—who for generations had considered it their obligation to contribute their expertise to the steering of the city as a whole. After the Civil War, this trend combined with the

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[1] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 309; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 3.
[2] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 385.
[3] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 5.

structural changes in the governmental landscape of the city to allow the rise of the professional politician. These were men who had never worked outside of politics but had mostly emerged from the brawling fire companies and street gangs to rise through the ranks of a new kind of organization—the political machine.[4] A few became so-called political bosses, controlling great amounts of money and influence chiefly from behind the scenes. Early bosses like "King" James McManes, William Stokley, and David Martin were more like leaders of corrupt rings and were not as powerful as those who came later. After a second reorganization of the city government in 1887, bosses like Matthew S. Quay and Boise Penrose at the state level and Israel "Iz" Durham, James P. "Sunny Jim" McNichol, and the Vare brothers (George, Edwin, and William) in Philadelphia relied on a state-city alliance and sometimes didn't even hold elective office, especially those at the local level. These later bosses acquired almost dictatorial power for a time.[5]

Political corruption was not unusual in late nineteenth-century America. In most cities after the Civil War, political bosses exercised their influence through the Democratic Party,[6] but in Philadelphia they made their home in the Republican Party. This was because in post-Civil War Philadelphia the Republican Party was the only game in town. At times, especially after 1887, the Democratic Party functioned as a mere "kept minority," literally bought and paid for by the Republican machine.[7]

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[4] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 2ff. The book is a published version of McCaffery's 1989 doctoral dissertation.
[5] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 41ff, 82ff. McCaffery argues persuasively that the early bosses functioned more like ring leaders, while the later political leaders were true bosses.
[6] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 496f. Tammany Hall in New York for example.
[7] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 134f.

How had the Republican Party come to so dominate Philadelphia's politics at this time? Partly because of its geographical position, the city had always had strong commercial, professional, and social ties with the South.[8] Philadelphia has been called "the most northern of southern cities"[9] not only for its geographical position. Nineteenth century Philadelphian folklorist and humorist Charles Godfrey Leland wrote that in Philadelphia "everything Southern was exalted and worshipped."[10] Despite its Quaker roots and pockets of fierce abolitionism, the majority opinion in the city prior to the Civil War was pro-South and pro-slavery.[11]

During the Civil War, the Democratic Party in Philadelphia had thrown its lot in with the South, openly sponsoring peace delegations and advocating for the Confederacy to win the war.[12] When the Union decisively won, the party found that its championing of pro-South, pro-peace, and anti-war positions had destroyed its political fortunes in the city. During the war, the Peace Democrats' opposition to military engagement with the Confederacy came to be perceived as unpatriotic; when the war proved winnable, they looked foolish as well. The Democratic Party within Philadelphia was so toxic in its disgrace that hardly any politicians were willing to be associated with it. Because the members of the city's upper class had allied themselves disproportionately with the Peace Democrats, they found themselves rejected by the greater populace.[13] The rending between the ruling elite and the lower and middle classes, begun in the years leading up to the Civil War, was completed. In the years immediately following the war,

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[8] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 366.
[9] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 355.
[10] Charles G. Leland, Memoirs (New York: D. Appleton, 1893), 136, quoted in Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 383.
[11] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 294ff, 297, 385ff, 391. Recall the burning of Pennsylvania Hall in 1838 and the anti-black riots of the 1840s.
[12] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 402ff, 411ff.
[13] Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 413 436ff.

the weakened Democratic Party mounted little serious opposition and allowed the Republican Party to entrench itself in a system that self-perpetuated for decades, well into the twentieth century.

One-party domination of politics, of course, is virtually never good over the long term. When the opposition party is weak for an extended period of time, its function as a counter-balance to the natural inclination by amoral and unscrupulous people to attempt to take advantage of opportunities to work toward their own ends is diminished. Moreover, when all of the branches of local government are controlled by the same party, the branches' functions as intra-governmental checks-and-balances wither as party control becomes ascendant. The result is nearly always a creeping lack of accountability and a resultant increase in corruption as people try to rig the system and reap the rewards.

In Philadelphia, such men were Republicans in name only, with no connection to the aims and goals of the Republican Party at the national level. They had no greater philosophy, no guiding principles, beyond the self.[14] A contemporary reformer observed:

> One party to them was as good as another so far as principles were concerned. The main consideration that influenced their actions was opportunity for self-advancement. With the Democratic party laboring under reverses, and the Republican party successful in city and state their lot was, of course, cast with the latter.[15]

A generation later, Elihu Root, Secretary of War under Theodore Roosevelt, called such individuals, "a corrupt and criminal combination, masquerading under the name of

[14] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 27, 47ff, 77ff.

[15] George Vickers, *The Fall of Bossism: A History of the Committee of One Hundred and the Reform Movement in Philadelphia and Pennsylvania* (Philadelphia, 1883), 64, quoted in Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 6, 206n.18.

Republicans."[16]

Most of these career politicians used their positions to accumulate personal wealth, although at least one was independently wealthy.[17] All of them also did what they did at least partly out of sheer pugnacity, the love of power, and the pleasure of winning. Most of those in the reform opposition were Republicans themselves, distressed, among other things, at what they saw as the hijacking of their party within the City of Philadelphia.[18]

In other words, neither political party was inherently more or less corrupt than the other. Unprincipled schemers often rose to dominate whichever party was stronger in any given location. In many American cities at the time this was the Democratic Party;[19] in Philadelphia it was the Republican.

The machine was not, as some have suggested, a benevolent provider of services as a necessary replacement for a dysfunctional city government.[20] It did not arise in response to the needs of the people but instead exploited the immigrant classes and urban poor who were already the most disadvantaged. Their needs were "decent housing, good schools and hospitals, clean water, full employment, and racial integration,"[21] as well as a lower cost of food and basic necessities. The bosses' petty welfare, in contrast, was small, sketchy, and unsystematically

[16] Elihu Root to John Weaver, Mayor of Philadelphia (15 Jul 1905); *Engineering News,* Vol. LIV, No. 3 (20 Jul 1905), 80; *Baltimore Sun* (18Jul 1905), 7. Alternating between private practice and public service, Root advised numerous American presidents on a variety of foreign and domestic issues. He was one of the people most responsible for modernizing American political influence and transforming the country into a world power in the early twentieth century.
[17] Boise Penrose, for example.
[18] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 9, 26f.
[19] Boss Tweed's well-known Tammany Hall ring in New York City is an example.
[20] For example Robert K. Merton, *Social Theory and Social Structure: Toward the Codification of Theory and Research* (The Free Press, 1949), 71. See also Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), xvii, 123, 204n.14, 204n.15.
[21] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 125.

doled out to preferred individuals. In fact, the bosses abetted those who caused problems more than they helped those who were the victims of those problems.

The machine often hurt those who needed help the most. For years, for example, it aided and protected the sex slave market.[22] At the state and local level, charitable institutions were extorted by the threat of the withholding of funds into allowing the machine to skim a percentage off the top.[23] If a person got behind on their taxes, the city's Collector of Delinquent Taxes would place them on the delinquent list and fine them steeply. Some, including widows and orphans, eventually owed so much they could no longer afford their mortgage and found themselves on the street when the machine bought up their property.[24] The corrupt system also hurt honest businesses while benefiting favored cronies.[25]

Corruption had a broad financial impact upon the city as well. Numerous methods of graft made everything more costly to municipal agencies so that much of what was paid for cost more than it would have otherwise. For example, crooked contractors were directed to charge more than they ordinarily would have and then divert a percentage of the overpayment back to the political bosses, both for the bosses' own wealth and to fund the political machine. As malfeasance became pervasive, the result was that the City of Philadelphia got less "bang for its buck" than it should have whenever it purchased or built anything. This was seen to a greater or lesser extent with virtually all of the city services and infrastructure during the late nineteenth century, including the water system.

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[22] Rudolph Blankenburg, "Forty Years In the Wilderness: Law and Order," *The Arena,* Vol. XXXIV, No. 189 (The Brandt Press: Trenton, Aug 1905), 133. See also Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 178, 237n.57.
[23] Rudolph Blankenburg, "Forty Years In the Wilderness: Law-Makers Who Shame the Republic," *The Arena,* Vol. XXXIII, No. 185 (The Brandt Press: Trenton, Apr 1905), 353.
[24] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 572f.
[25] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 132, 229n.55.

There was a moral cost to the corruption as well, as citizens were forced to do things that were contrary to their principles or just plain instinctively wrong. Municipal employees were forced to contribute a certain percentage of their pay to the machine, for instance, and some of the money funneled back to the machine was boldly used to literally pay people to vote the way they were told. Voters encountered widespread fraud and ballot manipulation, often in the form of physical intimidation and outright violence at the polls.[26]

It took the efforts of multiple generations of both reformers and ordinary citizens to decisively combat the late nineteenth century corruption. It wasn't until the 1930s that the tide finally began to turn.[27] As Eli K. Price, the architect of the 1854 Consolidation, expounded in 1872, it doesn't matter much what governmental structures are in place, immoral or amoral people will find ways to twist them to their own ends if allowed to do so:

> Still great, very great, evils may, and will, and do assail us. The machinery of government may be the best that can be framed by man; yet if the public servants lack ability and vigilance it will not work well. If the life of the living body become corrupt the canker is deadly, and must be utterly exscinded to save the life. That duty of excision rests with the people, and their vigilance is of ceaseless necessity; a duty to be executed fearlessly and as unsparingly as we deal with criminals who commit theft, burglary, or arson.
>
> This delinquency is the most dreadful depravity that a Republic can have to deal with; for it is treason to the fundamental principle of free government, that of trust in the public servants. When the sense of honesty in these is lost, those elected to protect the public become its deadly enemies; and besides the instincts of the thief these incur the odium of the

[26] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 165; Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 413 534ff, 583.
[27] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 184f.

> meanness of treachery, falsehood, and deception. The official who steals the public money commits the crime of theft and also betrays a public trust; is guilty of treason to his own manhood, for he loses all sense of honor. If infamy can have its grades, his must be the lowest. He also commits treason to the Republic, imperils law and liberty, and makes way for despotism. Such an one should find no forgiveness; and his crime should be accounted an unpardonable sin.[28]

Against this backdrop, successive Chief Engineers of the Water Department (and Bureau of Water after 1887) attempted to manage and improve Philadelphia's water system in order to meet the needs of a growing city.

In January 1861, Birkinbine had recommended that the breast wheels in the Old Mill House be replaced with turbines as soon as the New Mill House was operational.[29] Two years later, with the turbines in the New Mill House working well,[30] Cassin noted that Frederick Graff (Sr.) himself had wanted to replace the breast wheels with turbines;[31] he repeated Birkinbine's recommendation.

The reasons were manifold. With the nation nearly two years into the Civil War, industrial output in Philadelphia had increased. Prior to the war, the city had begun to establish itself as a manufacturing center, producing locomotives, ships, iron machinery, and a host of other heavy goods. Much of that, as well as rifles, munitions, and uniforms, was now being directed to the war effort.[32] In many ways, the Civil War years saw a full flowering of trends toward industrialization begun decades prior, especially in the northern states. Cassin warned

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[28] Eli K. Price, *The History of the Consolidation of the City of Philadelphia* (Philadelphia: J. B. Lippincott & Co., 1873), 135f.
[29] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 20.
[30] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 14.
[31] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 9.
[32] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 397f.

that Philadelphia's demand for water was growing faster than the population. He pointed out that in the time it had taken the city's population to grow by a third, its consumption of water had doubled. Noting that water systems had virtually never provided a sufficient supply as long as predicted when first designed, Cassin emphasized the need to get ahead of the increasing demand.[33]

The aging pumps in the Old Mill House now required constant attention and expensive maintenance to prevent them from failing.[34] Coupled with the old and deteriorating breast wheels, which were less efficient than turbines and were stopped by the rising tides on average twice a day, it's easy to see why Cassin described the situation in the Old Mill House an "immense waste of water."[35]

Although Birkinbine had recommended installing turbines in the Old Mill House, Cassin went further and in 1863 provided a cost estimate: $112,000,[36] including $18,000 for modifications to the building, $10,000 for the removal of the breast wheels, $60,000 for the manufacture and installation of the turbines and gearing, and $24,000 for the manufacture and installation of new pumps.[37] Cassin noted that the system of breast wheels and pumps in the Old Mill House were currently pumping less than thirteen million gallons per day, with significant downtime during high tides, while a set of turbines would pump an estimated forty million gallons per day operating continuously.[38]

The obsolete system in the Old Mill House wasn't the only impediment to increasing the supply from Fairmount. All of the water sent to the Corinthian Avenue Reservoir was forced

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[33] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 7f.
[34] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 9.
[35] Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 9.
[36] The equivalent of approximately $2.6 million in 2022.
[37] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 10ff. The figure did not include the cost of replacing the ascending mains with larger ones.
[38] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 10.

through a 30-inch main connected to the base of the Standpipe. Cassin pointed out that although the pumps in the Old Mill House raised water to the Fairmount Reservoir well enough, they had always struggled to pump water to Corinthian Avenue. Now that the New Mill House was operational and its pumps were pushing additional water through the same main, the situation was all the worse. The undersized main was simply overwhelmed.

At the base of the Distribution Arch, recall, Birkinbine in 1861 had wisely included a provision for a connection to a future 48-inch main. He had said that the existing main had a capacity of only eight million gallons per day and predicted it would be sufficient for only two or three years.[39] Like Birkinbine, Cassin believed the full potential of the New Mill House would not be realized unless a 48-inch main to the Corinthian Avenue Reservoir was installed and declared that the existing main's efficacy hadn't even lasted a year. He recommended laying the additional main immediately.[40]

Cassin was Chief Engineer for only two years; these two recommendations, converting the Old Mill House to turbines and constructing a 48-inch connecting main to the Corinthian Avenue Reservoir, would eventually be implemented but not during his tenure.

During Cassin's two years, he was most successful in keeping the need to increase the supply of water before City Councils, which would eventually fund the effort, but he did have a few minor achievements as well. With record-breaking crowds visiting Fairmount,[41] Cassin addressed various issues related to the grounds. In 1862 he refurbished the Mercury Pavilion, for example, and replaced the wood columns.[42] The same year he constructed a protective enclosure

[39] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 52.
[40] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 14; Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 8.
[41] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 33f.
[42] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 33.

for the stopcocks located on the hillside between Standpipe and Distribution Arch, intended to prevent them from freezing.[43] Two years later he installed a hot water heating system in the New Mill House, replacing the coal stoves previously used. In addition to protecting the machinery from freezing, the new system produced a cleaner, more evenly comfortable work environment.[44]

In 1864 Councils returned Henry P. M. Birkinbine to the helm of the Water Department. This time Birkinbine served for three years. The first thing he turned his attention to was the Fairmount Dam. Taking advantage of a few days which saw a combination of low water and unusually low tides, he conducted a thorough inspection of the structure in December 1864.[45] Recall that the dam was constructed from 1819 to 1821 and became operational in 1822. It was a 1600-foot-long system consisting of the lock structure of the Schuylkill Navigation system at the western end, a 1,204-foot-long central overfall portion, and the Pier, 270-foot-long Mound Dam, and 104-foot-long Forebay Bridge at the eastern end. A 450-foot-long portion of the overfall structure descended up to 19 feet below the level of low tide. In this area the foundation consisted of cribs of wood timbers filled with crushed rock resting on the river bottom. The foundation of the remainder of the overfall to the west was the bedrock itself at a shallower depth.[46]

Birkinbine recognized that "on the security of the dam at Fairmount depends the entire ability of the Fairmount, Schuylkill, and Twenty-fourth Ward Works to supply their respective districts."[47] Fairmount Dam had since its construction been the keystone component of the city's

[43] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 33.
[44] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 22.
[45] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 18.
[46] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 18f.
[47] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 13.

water supply system. The Fairmount Pool, from which now nearly ninety percent of the city's water supply was drawn,[48] backed up approximately six miles behind the dam.[49] A failure of the dam would have catastrophic consequences for the City of Philadelphia. As Birkinbine put it, "Accidents, resulting in injury or destruction of the dam, from any cause, would certainly result in failure of the supply, as temporary arrangements could not be made sufficiently expeditiously for prevention."[50]

In 1861 and 1862, during his first tenure as Chief Engineer, Birkinbine had recommended that Fairmount Dam, which had not had any serious work done on it since the decayed wood above the low-water mark was replaced in 1843,[51] be rebuilt in stone.[52] He acknowledged that this would "require more than double the outlay" but stressed the permanence of such a design.[53] Since materials acquisition would take approximately a year and construction at least two years after that, Birkinbine had urged early action.[54]

Now three years later, Cassin had served as Chief Engineer in the intervening years. Cassin had not only repeated Birkinbine's earlier call for a stone dam but went as far as to propose adding two gated sluiceways which when opened would serve to periodically scour away the silt deposits which had built up behind the dam.[55] Nothing, however, had been done toward such a project.

When Birkinbine now examined the dam, he found that much of the foundation cribbing

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[48] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 38. At this time the Schuylkill River was the source of 88.3 percent of the city's supply.
[49] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 18f.
[50] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 13.
[51] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 19.
[52] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 19; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 10.
[53] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 19.
[54] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 10.
[55] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 12f.

was insecure and parts of it were missing. The rock fill had washed out in places and some of the remaining timbers were sagging.[56] One portion, in the deepest part of the river, was in such bad shape that he believed the dam was at imminent risk of failing. Birkinbine thought the threat so great that he immediately began repairs without waiting for Councils to appropriate funding.[57] A reconstruction in stone would have to wait; Fairmount Dam needed to be made safe now. He sunk a gabion crib in front of the weak area in order to shore it up.[58]

While making the emergency repairs, Birkinbine implored Councils to provide funding for more substantial work. Since he estimated rebuilding in stone would cost at least $500,000[59] and thought it unlikely such an amount would be obtained, he instead recommended constructing a gabion crib structure of timber filled with crushed rock, similar to the dam's original design, directly in front of the downstream side of the dam. He further recommended incorporating a sluiceway, similar to Cassin's earlier proposal and for the same reason.[60]

City Councils made a loan available on 5 May 1865. Before work could get underway on the renovation, a spring freshet occurred which washed so much ice and debris against the dam that Birkinbine feared it would give way. The dam held, which Birkinbine attributed to the shoring up done in front of what was believed to be the shakiest portion of the dam during the previous winter.

Construction began shortly afterward. Birkinbine arranged for a new gabion structure, consisting of eight-foot-square compartments of heavy timber cribs filled with crushed rock, to be built in front of the downstream face of the original gabion foundation which had been

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[56] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11.
[57] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 18.
[58] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11f.
[59] The equivalent of approximately $9.3 million in 2022.
[60] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 19f, 80.

constructed across the 450-foot span where the river was the deepest. The bottom course of timber, which rested upon the river bottom, was composed of flitched hemlock. The rest of the timbers were flitched white pine. The downstream side of the new structure was faced with eight-inch-thick white oak timbers and the top decked with ten-inch-thick white oak planks.

In order to sink the structure in sections, half of the compartments within the gabion cribs had closed bottoms so that they would descend as they were filled with rock. In the crib compartments with open bottoms, the rock fill rested on the river bottom. The cribs were placed against the original structure of the dam and extended thirty feet downstream from it. The new portion was constructed up to just below the level of low tide and would serve as the foundation, in the deepest part of the river, for the rest of the structure above it. Along the remaining 754 feet across the river, the structure would rest directly upon the bedrock which was at a much shallower depth.[61]

Floodwaters destroyed progress on the work multiple times throughout the year, causing delays and additional expense. During one such high water event in July, a portion of the wall between the guard lock of the Schuylkill Navigation system and the western abutment of the dam washed away, creating a serious concern that the dam itself would be torn from the river bottom at that end. Substantial repairs were made and the dam held. The October 1865 contract deadline came and went, however, without the work being finished. Early in 1866 the contractor abandoned the project and the work was completed by employees from the Water Department's own workforce shortly after. The total cost came to $46,784,[62] including $2,570[63] for the repairs

[61] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11f.
[62] The equivalent of approximately $871,500 in 2022.
[63] The equivalent of approximately $47,900 in 2022.

to the canal wall.[64]

While the renovation project was still underway, Birkinbine mentioned that "a shoot [chute] will be arranged, to allow fish to pass up above the dam" and called for legislation to prevent fishing near it[65] but there are no later references to it nor evidence for such a feature. Because of the project's schedule and cost overruns, this element was likely dropped from the design and not constructed.

By 1865 it was apparent that the turbines in the New Mill House had not initially achieved their projected efficiency. Although Geyelin's model had demonstrated 82.10 percent efficiency during the competition in 1859 and 1860,[66] the full-scaled turbines were only operating at a little over 70 percent efficiency.[67] Birkinbine attributed this discrepancy to a failure by the manufacturer, the I. P. Morris foundry, to fabricate certain components to contract specifications and to poor workmanship of other elements. For example, the teeth of the bevel gears were made of wood and Birkinbine found that unseasoned, poorly dressed wood had been used, resulting in the need for constant attention and early replacement. He believed the undersized 30-inch main to the Corinthian Avenue Reservoir was a significant contributing factor to the underperformance as well. As improvements were made, Birkinbine predicted, incremental gains in the turbines' efficiency would be realized.[68] The next year he reported that although there was "still room for improvements," the deficient aspects of the machinery had been largely corrected.[69]

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[64] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11f, 62, 78, 79f; Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 14f, 77.
[65] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 62.
[66] Water Department, *Report on the Experiments with Turbine Wheels* (1861), 12, 40, Table 21 at 42, Exhibit D at 54.
[67] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 270.
[68] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 21.
[69] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 14.

Birkinbine estimated the total pumping capacity of the three turbines in the New Mill House to be 16 million gallons per day.[70] Even during times of plentiful rainfall when the availability of water power at Fairmount was at its greatest, however, the output of the New Mill House was an average of less than 14 million gallons daily. During dry periods, it dropped to less than 8 million gallons per day.[71] Still, Birkinbine calculated that had the steam-powered Schuylkill works been used to pump the amount of water that the New Mill House had during 1964, it would have cost the Department an additional $47,190.[72]

With the performance of the New Mill House turbines tweaked as much as possible for the moment, Birkinbine next turned his attention to the system's downstream chokepoint, the 30-inch main. He had designed the New Mill House to operate with a 48-inch main and its turbines could not be worked to their full capacity without it.[73] Cassin had twice asked for its construction;[74] now Birkinbine renewed the call. "At present," Birkinbine asserted in February 1865, "all of the water pumped by the new wheels, is forced through one thirty-inch main, which is not of sufficient capacity to vent it properly." He insisted that no further increase in the output of the New Mill House would be achieved without it.[75]

Construction on the 48-inch main to the Corinthian Avenue Reservoir finally got under way later in 1865. Birkinbine had originally estimated it would cost $125,000.[76] Even though

[70] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 14.
[71] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 14; Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 14. These figures result from a comparison of the total combined average daily output of both the New Mill House and Old Mill House reported in the Annual Report for 1865 with the estimated pumping capacities reported in the Annual Report for 1864.
[72] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 22. The amount was the equivalent of approximately $890,200 in 2022.
[73] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 14; Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 63f.
[74] Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 14; Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 8.
[75] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 4.
[76] Water Department, *Report Upon the Extension of the Water Works* (31 Mar 1864), 4. The amount was the equivalent of approximately $2.4 million in 2022.

most of the route had to be carved out of the underlying rock with great difficulty, the main was completed in 1866 at a total cost of $80,675,[77] a rare case of a Birkinbine project coming in far under the projected cost.[78]

Prior to its completion, Birkinbine estimated that the 48-inch main would allow the New Mill House to increase its capacity by at least 25 percent.[79] He was right. After the new main was finished, the nominal capacity of the new Mill House increased to 20 million gallons per day and on 21 Aug 1866 a record 21,380,300 gallons was pumped to the Corinthian Avenue Reservoir.[80] "The new [*sic*] Mill House," Birkinbine fairly crowed, "may be said to be completed. The full capacity of these works can now be used."[81]

In 1866, another connecting main was completed which further increased the utility of the New Mill House. A 30-inch main was constructed from the Corinthian Avenue Reservoir to the Delaware Works' Lehigh Avenue Reservoir. This allowed the New Mill House to supply water to the Kensington area—doubling the supply there—via the Corinthian Avenue Reservoir. The new connecting main also meant that better quality water could now be supplied to the residents of Kensington, serving to somewhat displace the polluted water being drawn from the Delaware. The original undersized 18-inch main from the Delaware Works to the Lehigh Avenue Reservoir was repurposed as an ordinary distribution main. The cost of the project was $156,318.[82]

The Old Mill House, though, was performing as poorly as the New Mill House was

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[77] The equivalent of approximately $1.5 million in 2022.
[78] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 63f; Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 58.
[79] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 63.
[80] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 16.
[81] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 58.
[82] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 58. The amount was the equivalent of approximately $2.9 million in 2022.

succeeding. The current situation was becoming untenable. Maintenance of the aging and obsolete breast wheels was becoming increasingly difficult and costly. In February 1865 Birkinbine reported,

> The dilapidated condition of the old works at Fairmount, makes it necessary to do something at once. It is almost impossible to keep them in running order.[83]

Because the oldest breast wheels, Nos. 4 through 8, "were made as heavy as possible, under the mistaken idea that the momentum of the rim would add to the efficiency of the wheel," they were very difficult to maintain in good repair. All of the pumps but the one for Wheel 4 had broken parts and were running damaged.[84]

By 1866 the eight breast wheels required so much ongoing work that if it weren't for the expectation that they would soon be replaced, Birkinbine said he would already have requested $40,000 to permanently repair them.[85] To make matters worse, the freshet during June 1865 damaged Wheels 5 and 6 so much that they required virtual rebuilding.[86]

The pumps were just as bad. Because of accumulated wear, they all needed their pump chambers re-bored and new pistons installed. Nearly all of them required significant additional work, from new valve boxes to new main shaft bearings to new crank pins. The pump for Wheel 7 needed to be scrapped and replaced altogether. Wheels 4 and 5 needed new breastwork, the stone masonry which fitted closely to the curve of the wheel. The gates, flumes, and other woodwork were so decayed that Birkinbine feared much of it would break away against the pressure of another severe freshet.[87]

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[83] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 3f.
[84] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 20. Wheels 1 through 3, recall, were rebuilt in 1846.
[85] The equivalent of approximately $745,000 in 2022.
[86] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 13.
[87] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 13f.

Even the building itself was difficult to maintain due to the use of wood in the moisture-rich environment. Wood was used extensively in the structural elements of the roof and in the trim and other components of the interior.[88] In fact, the inherent problems with maintaining the wood in the Old Mill House had inspired Birkinbine to design the New Mill House without it.

In light of the proposed replacement with turbines, however, Birkinbine believed it didn't make any sense to sink a lot of money into maintaining the breast wheels and their pumps.[89] As it was, the Department had to employ two millwrights who did nothing but work to repair the wheels; additional workers were often needed to help. The wheels and pumps had deteriorated to the point that even this level of effort was just the bare minimum required to get by—and it risked catastrophic failure.[90]

The city could not afford to have the breast wheels and pumps fail. The Fairmount Water Works was the water system's keystone facility, contributing over 72 percent of the total supply in 1866.[91] Despite an aggressive program of fixing leaks in distribution mains and combating waste (with the help of the police department), demand exceeded supply several times that year.[92] With now only a two days' reserve in the reservoirs, some of them were nearly emptied.[93] Without an increase in pumping capacity, the outlook was grim.

Birkinbine believed the answer lay in the oft-recommended substitution of turbines for the breast wheels in the Old Mill House. He repeatedly pressed for this and in 1864 estimated the cost at $200,000[94] ($88,000 more than Cassin has estimated just a year earlier), including $160,000 for removal of the breast wheels and manufacture and installation of turbines and

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[88] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 58f.
[89] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 13.
[90] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 13f.
[91] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 17, 34.
[92] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 33.
[93] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 34, 35.
[94] The equivalent of approximately $3.8 million in 2022.

pumps and $40,000 for modifications to the building.[95] He calculated that a switch to turbines would increase the capacity of the Old Mill House by 10 million gallons per day.[96] This represented a nearly 50 percent increase in output at Fairmount and an increase in the system-wide pumping capacity of slightly over a third.[97] Birkinbine also urged an expansion of the overall reservoir capacity, to at least 500 million gallons.[98]

Birkinbine made a recommendation regarding the Engine House that would have significantly altered the character of the Fairmount Water Works. He proposed installing a Cornish steam engine with a capacity of ten million gallons per day in the central area where the public refreshment stand was located. This steam engine would be held in reserve for times when the water in the Fairmount pool was insufficient to provide enough power to effectively run the turbines and breast wheels. It could draw water from either above or below Fairmount Dam and would serve as an emergency backup in case of a catastrophic failure of the dam. Such a project likely would have involved the removal of the interior floor divisions and a returning of the Engine House to a character similar to when it was first constructed. Although he considered this to be as important as installing turbines in the Old Mill House, the proposal was never carried out.[99]

Birkinbine did not confine himself to short-term concerns. In 1866 he reported that the average daily consumption per capita had grown from 12.5 gallons in 1830 to 41 gallons in 1865, a 228 percent increase.[100] He predicted that if the population grew apace, by 1885 the average

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[95] Water Department, *Report Upon the Extension of the Water Works* (31 Mar 1864), 3.
[96] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 15.
[97] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 17, 34.
[98] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 35.
[99] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 81; Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 60.
[100] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), table at 31.

daily demand would be between 150 and 200 million gallons,[101] spectacularly more than the current demand of slightly over 30 million gallons.[102]

Because of what looked to be an ever-expanding demand, Birkinbine foresaw the eventual need to procure a much greater quantity of water than was then being pumped. He convinced City Councils to appropriate $3,000[103] in the spring of 1864 for a study of possible options. After extensive surveys, Birkinbine submitted a report in February 1866 in which he evaluated thirteen potential sources of water in a broad area arcing around the north and west of the city.[104]

After dismissing twelve of the sources from further consideration for a variety of reasons, from low flow to high levels of farm runoff to high costs of purchasing extensively developed property,[105] he proposed damming the Perkiomen Creek at a point approximately 26 miles north of Broad and Market Streets[106] and bringing water to the city by aqueduct.[107]

Birkinbine estimated the system would produce approximately 75 million gallons per day, enough to meet projected demand until 1875.[108] The proposed system would be expandable up to a daily production of 240 million gallons, far more than the projected demand as far out as

[101] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 67.
[102] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 30.
[103] The equivalent of approximately $56,600 in 2022.
[104] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866).
[105] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 6ff.
[106] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), map at 14. Just south of today's Green Lane Reservoir.
[107] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 15ff.
[108] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 18, 22.

1885.[109] Birkinbine estimated the initial system would cost approximately $10 million,[110] including one million for the Perkiomen reservoir, six million for a 24-mile aqueduct into the northern portion of the city, one million for a reservoir inside the city, one million for four 48-inch connecting mains, and one million for contingencies.[111] He pegged annual operating expenses at $352,000.[112] With only a $3,000 appropriation for the study, Birkinbine asserted it was impossible to estimate the cost of the expanded system, but he thought it would likely pay for itself with the increased revenue which would be generated.[113] He requested $12,000[114] to begin design work, such as detailed surveys, plans, and specification.[115]

The plan was not met with public enthusiasm. A year later, Birkinbine defended his proposal, answering a series of objections which had been raised against it, but it never gained traction.[116]

Fairmount continued to be a major public attraction. After noting that "these grounds are thronged every pleasant day with thousands of our citizens"[117] and "constantly crowded with visitors,"[118] Birkinbine groused that the funds appropriated for the maintenance, upkeep, and improvement of the grounds—which constituted 32 acres of the most prominent parkland in the city—were consistently inadequate. Twice Birkinbine proposed Councils create a permanent

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[109] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 21, 22.
[110] The equivalent of approximately $186.3 million in 2022.
[111] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 24.
[112] The equivalent of approximately $6.6 million in 2022.
[113] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 26.
[114] The equivalent of approximately $223,500 in 2022.
[115] Henry P. M. Birkinbine, *Preliminary Surveys for Procuring a Supply of Water by Gravitation, for the City of Philadelphia, From the Perkiomen,* (Philadelphia: Feb 1866), 27.
[116] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 7ff.
[117] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 42.
[118] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 60.

annual appropriation of $10,000[119] which would combat the constant wear and tear and allow for "some marked improvement every year."[120] Although Birkinbine included a list of suggested improvements which this might fund, such as a pavilion near the Green Street entrance, enhancement of the popular and often-crowded spring on the north side of Fairmount Reservoir, and even a vine-covered trellis atop the New Mill House,[121] the recommendation was never implemented.

One of the popular attractions which might have been perpetuated by a permanent annual appropriation was the afternoon concert. Throughout the summer of 1865 a band played in a temporary bandstand in the South Garden. The arrangement was entirely paid for by some of the local railroad companies and the operator of the refreshments concession in the Engine House,[122] likely as an promotional opportunity. The concerts were so well attended that Birkinbine proposed erecting a permanent bandstand with seating for listeners, but this was never done.[123]

In the absence of a permanent funding source, Birkinbine managed to find the resources during his second tenure as Chief Engineer to pay for not only the regular maintenance of the grounds at Fairmount but numerous improvements as well. The carriage drive was extended from the Green Street entrance along the northern edge of Fairmount Reservoir to the Distribution Arch. A new walkway was created on the western side, nearer the Callowhill Street entrance. A total of 8,000 square yards of drives and walkways were graveled and repaired,

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[119] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 42; Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 60. The amount was the equivalent of approximately $186,300 in 2022.
[120] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 60.
[121] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 42.
[122] Begun in 1835, the popular concession became a fixture in the Engine House, continuing through the middle and late nineteenth century. When Graff, Jr., became Chief Engineer again in 1867, one of the first things he did was re-bid the operation. See "Sealed Proposals Will Be Received," *Philadelphia Inquirer,* (3 May 1867), 7. Thirty years later, the ice cream sold there was mentioned as one reason to visit the Fairmount Water Works. See "Trips Awheel: Where to Go and How to Get There," *Philadelphia Inquirer,* (25 Jul 1897), 36.
[123] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 59f.

5,302 feet of edging were renewed, 2,110 yards of sod were relaid, an additional 345 seats and 86 benches were installed, trees were trimmed, dead trees were replaced, and climbing vines and ivies were planted. A large decorative urn was even placed among the switchbacks of the North Cliffside Path below the Distribution Arch.[124]

In the interest of public safety, Birkinbine saw to it that the floor of the public area on the main level of the Engine House was repaired. Decayed joists were replaced and a new floor surface was laid, a not insignificant safety improvement considering the Engine House was "often filled to capacity by visitors."[125]

In an attempt to stop the roof of the New Mill House from leaking, the flagstone pavement of the deck was taken up and reinstalled but the leaking continued. Additional repairs would be necessary.[126]

The reader today may be forgiven for thinking that vandalism is strictly a modern problem, but it has long been an issue, if not precisely at today's level. It was enough of a concern at Fairmount that Birkinbine proposed tougher anti-vandalism legislation, opining, "a fine of not less than twenty-five dollars and imprisonment of at least thirty days, in all cases where parties are convicted, would not be too severe." City Councils ignored the request.[127]

In 1866, four "rustic summer-houses" were constructed.[128] Three were completed the same year—one along a walkway on the reservoir slope above the southern edge of the South Garden overlooking the Wire Bridge, one at the crest of the northeastern corner of the reservoir

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[124] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 58f; Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 36.
[125] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 41.
[126] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 41.
[127] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 60.
[128] These may have been designed by famed architect Frank Furness at the inception of his independent practice. See "Building in Philadelphia," *American Architect and Building News* (14 Oct 1876), 335; George E. Thomas et al, *Frank Furness: the Complete Works* (New York: Princeton Architectural Press, 1991), 148.

above the Green Street entrance, and one at ground level in the North Garden near the lower fountain.

The fourth of the structures, completed the following year,[129] was built in a commanding location—midway up the western slope of the reservoir, directly overlooking the South Garden, at the convergence of the Central and South Cliffside Paths. Despite its rough-hewn quality, it was more elegant and picturesque than the other three and received the lion's share of attention between them. It quickly became a popular subject for photographers and was eventually known simply as the "Rustic Pavilion."[130]

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After an eleven-year absence, Frederic Graff, Jr., was again elected Chief Engineer by City Councils in March 1867.[131] The first thing he did was conduct a thorough examination of what he called "that all important structure," the Fairmount Dam.[132] Similar to the situation Birkinbine found just three years earlier, Graff discovered that a "considerable" amount of the crushed-rock fill had again washed out "from several places" and caused the timber cribbing to

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[129] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 36.

[130] Many stereographs from the period are extant. See for example James Cremer, Fairmount Water Works Rustic Building, print, photographic (c.1870), accession 2004.090.0075 (Fairmount Park Commission Collection); James Cremer, Fairmount Water Works Rustic Building, print, photographic (c.1870), accession 2004.090.0077 (Fairmount Park Commission Collection); James Cremer, Fairmount Water Works Rustic Building, print, photographic (c.1870), accession 2004.090.0078 (Fairmount Park Commission Collection); I. Ropes & Co., No. 2, Peace Fountain, film negative (c.1870), accession 2004.084.0102 (Holstein Stereoview Collection); James W. Queen & Co. No. 7, Hum's Philadelphia: Rustic Summer House, film negative (c.1870), accession 2004.084.0130 (Holstein Stereoview Collection); Unknown photographer, Rustic Gazebo on Cliffside Walk (c.1868), accession Graff05.67.12 (Graff Collection, The Franklin Institute); all accessed via Philadelphia Water Department Historic Resource Archives.

[131] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 5; *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 3.

[132] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 5.

sag once more. The fill was replaced and the timbers were renewed.[133]

After ensuring the dam was secure for the time being, Graff's next priority was increasing the supply of water. Believing that the four operating turbines pointed the way forward, Graff declared that the next step was the conversion of the Old Mill House from breast wheels to turbines. Graff proposed replacing six of the breast wheels, Wheels 2 through 7, with three turbines and six pumps of similar design to those in the New Mill House.[134]

As with the turbines in the New Mill House, those in the Old Mill House would be of the Jonval type. Although larger than their predecessors, they would in like fashion each drive a pair of double-acting pumps. Graff estimated that each turbine-and-pump set would be capable of raising five million more gallons per day than the two breast wheels and their pumps which it would replace.[135] With three turbines planned to be installed, this meant an projected 15-million-gallon-per-day increase.

The replacement of six breast wheels and six pumps with three turbines and six pumps would require radical surgery on the Old Mill House. Because the new machinery could not fit into the same space, the building had to be enlarged and the interior completely rearranged. It was necessary to push portions of the external river wall out an additional seven feet[136] and excavate deeper into the solid rock beneath the building, down to 13 feet below high tide.[137]

The longitudinal peaked roof and the promenade terrace on the Forebay side would need

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[133] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 5f.
[134] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 6f. As in the New Mill House, each turbine would drive two pumps. Graff also proposed replacing Wheels 1 and 8, the breast wheels on either end, with smaller turbines, but this was never done. See Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 6; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 109.
[135] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8; *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 786.
[136] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8.
[137] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 5.

to be removed. The top of the Forebay wall would be raised to the same level as the top of the river wall and a flat deck constructed at the same level from the Forebay wall in the back to the river wall in the front.[138]

Graff was fully aware of the international fame the Fairmount Water Works enjoyed and designed the new exterior to conform to the classical appearance which had come to be associated with the site.[139] Dressed cut stone from a quarry along Crum Creek in Leiperville, approximately fifteen miles southwest of Fairmount,[140] would be used to match the original walls.

There was a significant obstacle to reconfiguring the Old Mill House from breast wheels to turbines, however. The eight breast wheels in the Old Mill House may not have been pumping as much water together as the combined three turbines in the New Mill House, but the amount they did produce was still significant[141] and the city simply could not afford to lose it all at once.

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[138] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8.

[139] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7.

[140] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5. German immigrant Thomas Leiper (1745–1825) settled in Delaware County, Pennsylvania, and established numerous businesses, including a snuff factory and stone quarry. The quarry was located at what is now South Chester Road (Pennsylvania Route 320), just south of its intersection with Parklane Road and Mt. Holyoke Place, just east of mile marker 1.4 on Interstate 476 (known locally as "The Blue Route"). It supplied curbstones, doorsteps, and building material in Philadelphia and the surrounding area. The stone was a granite gneiss, a type of metamorphic rock formed from granite. Like nearly all gneiss, it was finely banded in light and dark grey but, significantly, tended to not break along the band lines. At the time of the reconfiguration of the Old Mill House, the Leiperville quarry was operated by Callender I. Leiper, one of the sons of one of Thomas Leiper's nephews. The quarry was noted for the first operational railway in America, built by Thomas Leiper in 1790, and a canal, built by Leiper's son, George G. Leiper, in 1829. Both were constructed to transport stone to market because the local roadways were often too muddy to be easily passable. See "Thomas Leiper and family business records (finding aid)," *Library Company of Philadelphia, Philadelphia Area Archives Research Portal, Philadelphia Area Consortium of Special Collections Libraries* (2020), <http: //dla.library.upenn.edu/dla/pacscl/detail.html?id=PACSCL_LCP_LCPLeiper>, accessed 4 Feb 2020; "Ramble," *Some Little Crum Creek* (2010), <https://littlecrumcreek.wordpress.com/ramble/>, accessed 4 Feb 2020; "Leiperville Railroad," *Delaware County Daily Times* (13 Oct 1916), <https://www.newspapers.com/clip/694507/leiperville_rail/>, accessed 4 Feb 2020; and E. B. Hardin, "Granite gneiss at Leiperville quarry Crum Creek, Delaware County, Pennsylvania (photograph)," *U.S. Geological Survey, Folio 162, Figure 11* (1909), <https://www.sciencebase.gov/catalog/item/51dc7e22e4b097e4d3838e0c>, accessed 4 Feb 2020.

[141] At this time the Old Mill House produced approximately 43 percent of the Fairmount Water Works' total output. See Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 14.

Graff's solution to the problem was to reconstruct the Old Mill House in three phases, taking only two breast wheels offline at any one time.[142] The facility would be rebuilt roughly in thirds, from south to north. Wheels 2 and 3 would be replaced by a single turbine and two pumps first, followed by Wheels 4 and 5, and lastly Wheels 6 and 7. Graff proposed to replace Wheels 1 and 8 with smaller turbines at a later time.[143] The Fairmount Water Works would still see a roughly 10 percent decrease in capacity during the conversion, but this would be nowhere near the 43 percent reduction that would result if the entire Old Mill House were rebuilt at the same time, or even the 32 percent reduction if just the six breast wheels targeted for near-term replacement were out of commission at the same time.

Not insignificantly, this phased approach had the added benefit of not needing to be paid for all at once.

On 20 Jun 1867 Graff submitted to Councils a formal request for funds to begin.[144] Graff declared there was a "present imminent risk" of water shortage due to the insufficiency of the breast wheel system in the Old Mill House and insisted "the critical situation in which the City is placed…calls for the promptest action." He added that Councils needed to respond with "not a moment's delay."[145] Graff placed the responsibility for action squarely upon Councils, saying that if the bodies did not respond with funds before adjourning for the summer, "the consequences may be very disastrous, and I feel that a fearful responsibility will rest upon them."[146]

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[142] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 786.
[143] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5. This was never done.
[144] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 784ff.
[145] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 785.
[146] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 787.

Although Graff admitted the cost was difficult to estimate due to the blasting of rock and use of a cofferdam that would be required, as well as the necessity of maintaining in operation the breast wheels and pumps on either side of the construction,[147] he requested $125,000[148] to begin the first phase of the reconfiguration.[149] This amount included $60,000 for one Jonval turbine with its two pumps and single discharge main, $8,500 for one 36-inch ascending main to Basin 2 of the Fairmount Reservoir, $3,000 for work at the reservoir to receive the first ascending main and the next two anticipated mains, $8,000 for bridgework to carry three discharge mains across the Forebay, $3,000 for three cast iron head gates for the turbine flumes, $40,000 for alterations to the structure of the Old Mill House (including additional foundations, quarrying of wheel pits, sump pumps, and cofferdams). An additional $2,500 was requested for unexpected work which might prove necessary.[150]

The ten members of the joint watering committee, five from the Common Council and five from the Select Council, sponsored Graff's funding request.[151] Councils responded immediately with an appropriation for funds and work got under way in October 1867,[152] the earliest that conditions would allow. Graff chided Councils for not acting "several years ago" while the pumping capacity was better able to keep up with demand. Now, however, construction could not take place until after the time of year when the greatest demand for water had abated. It would need to continue through the winter, although this was the most difficult—

[147] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 786f.
[148] The equivalent of approximately $2.5 million in 2022.
[149] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 785, 787.
[150] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 787.
[151] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 784f.
[152] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7.

and therefore expensive—time of year for such work.[153]

Graff contracted with Emile Geyelin for the design of the turbine and its gearing and the installation of the turbine and pumps. Graff designed all other aspects of the work, including the pumps, mains, structural alterations, architecture, and construction staging sequencing. The turbine and gate hoist were manufactured in Geyelin's shop. Geyelin subcontracted the manufacture of the pumps and their drive shafts to I. P. Morris & Co., the production of the gearing, shafts, and crank wheels to the West Engine Company of Norristown, and the fabrication of the wrought iron flume and head gate to Hunsworth & Naylor.[154]

The necessary alterations to the structure of the Old Mill House required the installation of a temporary cofferdam in the river to keep water out during construction. It also meant blasting.

> The quarrying out of the rock upon the site of the wheel, to a depth sufficient to utilize the entire fall of water (about thirteen feet below high-tide), proved tedious and difficult. The work had of course to be done by the use of a coffer-dam [*sic*], and the larger part of it during the unusually severe weather of last winter. The rock was exceedingly compact, wet, and difficult to get the proper face upon it to admit of rapid blasting. [155]

Of course, as Graff had pointed out, needing to maintain in operation the breast wheels and pumps on either side made the work all the more difficult.[156]

The first turbine began operating on 17 Feb 1869, approximately sixteen months after construction began, "considerably more time than was anticipated," as Graff put it.[157]

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[153] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 786; Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7.
[154] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7; "Fairmount Water Works—New Wheels and Pumps," *Journal of the Franklin Institute,* Vol. LVII, No. 3 (Mar 1869), 148.
[155] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 5.
[156] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7.
[157] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 5.

While work on the first phase was ongoing, Graff reminded Councils that only the bare minimum of maintenance and repairs were being made on the remaining four breast wheels slated for replacement and urged prompt appropriation of funds for change-out of the next two wheels in 1868.[158] Keeping the remaining breast wheels productive was increasingly difficult. With two of them removed already, the city could not afford for any of the remaining to fail. It was even money, however, on which might break first, a wheel or a pump. The valve chests for every pump, for example, were cracked and patched, except for that of Wheel 1, and were "liable to fail at any moment." Graff had a new casting made and held in ready reserve for emergency replacement if such a failure occurred.[159]

Graff intended to start on the second and third phases in quick succession as soon as the first turbine began operating. Despite the challenge of keeping the creaking breast wheels going, however, the second phase was delayed approximately eight months from the planned start date by the failure of Councils to appropriate the necessary funds in a timely manner. The better part of an entire construction season was lost.[160] During this time, a temporary roof was installed over the work area.[161] Work to replace Wheels 4 and 5 with the second turbine finally began in early 1870.[162] The same alterations were done to the central portion of the building as in the first phase, but the work proceeded faster during this second phase. The second turbine began operating on 20 Jun 1870.[163] Shortly after, construction started on the third or northern phase,

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[158] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7f.
[159] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7.
[160] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 5; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 5; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5. *Communication* (1869) was also included as an appendix to the Annual Report for 1869.
[161] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7.
[162] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 5; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5.
[163] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5.

replacing Wheels 6 and 7.[164] The third turbine became operational on 14 Dec 1871.[165]

The Caretaker's House and Watering Committee Building—atop the south and north ends of the Old Mill House, respectively—were retained in their original positions. Where the North and South Entrance Portals once penetrated into the interior from the promenade along the Forebay, however, Graff constructed the one-story, rectangular North and South Entrance Houses atop the new deck. Each had its own entryway. The large surrounds of the old Entrance Portals—topped with William Rush's sculptures, *Allegory of the Water Works* and *Allegory of the Schuylkill River In Its Improved State*—were reused at the new entryways, facing the Forebay as before.

In what was perhaps a nod to an aspect of his father's original design that had gone unrealized,[166] Graff, Jr., crowned the central deck space between the North and South Entrance Houses with a large, rectangular, peristyle[167] Pavilion with Tuscan order columns. The Tuscan order was an architectural style developed by the Romans and re-popularized by Andrea Palladio. Recall that Graff's father, Frederick Graff, had drawn inspiration from Palladio in his design of the original configuration of the Old Mill House.

With an eye toward resistance to fire and sustainability in the moist environment,[168] Graff, much like Birkinbine had done with the New Mill House, designed the renovated Old Mill House virtually without wood. Moisture is the enemy of wood and the Old Mill House had moisture in abundance. In the original configuration, wood had been used for the roof, roof trusses, and support structures. This had resulted in the continual deterioration of these

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[164] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5.
[165] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 5f.
[166] Frederick Graff, *Old Mill House* (unknown date), model, wood, 30 5/8" long × 7 1/4" tall × 4 1/16" deep, Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University.
[167] Columns around the perimeter of a structure. In this case the roof was entirely supported by the columns. Together, the columns and roof enclosed an entirely open space within.
[168] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7.

components and a constant need for maintenance and renewal. In the new configuration, wood would be mostly confined to doorways and windows. The roof structure would have none—using a similar design to that of the New Mill House, Graff employed barrel-vaulted brick between horizontal wrought iron beams.

While Birkinbine had used cast iron columns to support the roof beams in the New Mill House, Graff employed in the reconstructed Old Mill House a newly developed product which had not been available to Birkinbine—the wrought iron Phoenix column.[169] It had been thought that only cast iron had the strength for structural columns. Although weak in tension, cast iron is strong in compression. Wrought iron is stronger in tension but not as strong in compression. Invented in 1862 by Samuel J. Reeves (1818–1878), Vice President of the Phoenix Iron Works in Phoenixville, Pennsylvania,[170] the Phoenix column used wrought iron in such a way that it was strong in both tension and compression.[171]

The Phoenix column consisted of segments of wrought iron strips that were longitudinally concave and had flanges along the long edges. When the flanges were riveted together, the strips formed a hollow tubular column able to support great weight. They were constructed of four to six strips or segments, the four-segment type being the most common and the type employed at the Fairmount Water Works. The finished product was hollow, so in addition to providing high compressive strength it was lighter than the traditional solid cast-iron

[169] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7. The annual report does not specify the type of vertical column, but photographic evidence reveals the Phoenix design.
[170] "Phoenix Steel Corporation Records, 1827–1963," *Manuscripts & Archives Department, Hagley Museum & Library* (23 Jul 2014), <https://invention.si.edu/phoenix-steel-corporation-records-1827-1963-bulk-1856-1949>, accessed 9 Feb 2020; "Album of Designs of the Phoenixville Bridge-Works," *Clarke, Reeves & Co.* (Philadelphia, 1873), Lehigh University Digital Library, <http://digital.lib.lehigh.edu/cdm4/bridges_viewer.php?ptr=1103&DMTHUMB=&CISOPTR=1061&view=de>, accessed 9 Feb 2020.
[171] Sara E. Wermiel, "Introduction of Steel Columns in US Buildings, 1862–1920," *Proceedings of the Institution of Civil Engineers, Engineering History and Heritage* (Feb 2009), 19ff.

columns and masonry then in use. And because it was assembled on site it could be shipped in a compact form. This made is easier and less expensive to move by rail.

The Phoenix column became one of the most widely used structural components in the United States, a distinction it held until the age of steel. Phoenix columns were used in bridge and building projects throughout the country. They formed the main structure of the original stairway and elevator shaft inside the Washington Monument in Washington, D.C., for example.[172] They may still be found in preserved historic bridges across the country.

Graff, Jr., installed 24 Phoenix columns in the Old Mill House as it was reconstructed, section by section, from 1867 to 1870. They were lighter and stronger than the solid cast iron columns used to support the roof of the New Mill House, constructed from 1859 to 1862.[173]

The use of iron and masonry for the roof and its support structure represented a major advance. While the upfront costs were higher, and the iron components were subject to corrosion if left unprotected, Graff, like Birkinbine before him, calculated that the maintenance costs were far lower over time.

Although the final Old Mill House turbine became operational in December 1871, and the great majority of the work was completed as the three phases had progressed, minor "finish work" on the building itself—wood platforms and staircases, stone flooring, interior plastering, and the balustrade around the deck—continued into 1872.[174] One of the last things to be

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[172] George J. Olszewski, *A History of the Washington Monument: 1844–1968* (Washington, D.C.: United States Department of the Interior: 1971), Ch. 5, <https://www.nps.gov/parkhistory/online_books/wamo/history/chap5.htm>, last updated 18 Nov 2003, accessed 9 Nov 2018.

[173] The Phoenix columns remained in place when the Old Mill House was converted into exhibit space for the Fairmount Park Aquarium in 1921, but unfortunately all were removed in 1986 when the deck and support structure were replaced by cast-in-place concrete during a major safety-related renovation which had been deemed necessary for modern public occupancy.

[174] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 6; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5.

completed was an up-to-date steam heating system, installed by local hardware contractors Pancost & Maule[175] and costing $2,500.[176] The new system replaced the coal stoves used in the building's original configuration since it was first built fifty years earlier. Finally, the portions of the breast wheels' discharge mains which crossed along the bottom of the Forebay were simply abandoned in place.[177]

The water-powered operation in the Old Mill House, like that in the New Mill House, was considered a marvel of mid-nineteenth century engineering technology.[178] At the Forebay wall the flow of water from the Forebay to each turbine was controlled by three cast iron sluice gates. Each gate was five feet high, seven feet wide, and was moved up and down by means of a jack screw and worm wheel operated by a large hand wheel positioned at the Forebay edge of the building's deck.[179] When the gates were raised, as they normally were, water passed beyond them and into a 24-foot-long flume on its way to a turbine. Each flume was 15 feet wide and eight feet high, and was constructed of ¼-inch-thick, wrought iron plates, butt-jointed and fastened with riveted, wrought angle-iron ribs.

As with the turbines in the New Mill House, the water entered from above. Marginally larger than those in the New Mill House, the turbines' nacelles (or casings) were 12 feet in

[175] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5. The Annual Report for 1872 is silent about whether or not the steam heating system was extended to either the Engine House or New Mill House, but it must not have been extended to the New Mill House at this time because the Annual Report for 1885 states that Chief Engineer Ludlow extended it to the New Mill House in that year, replacing the hot water heating system installed there by Chief Engineer Cassin in 1864.

[176] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 95. The amount was the equivalent of approximately $60,700 in 2022.

[177] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 158.

[178] Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862 1869), 51; Water Department, *Report Upon the Extension of the Water Works* (31 Mar 1864), 1; Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 5f; "Fairmount Water Works—New Wheels and Pumps," *Journal of the Franklin Institute*, Vol. LVII, No. 3 (Philadelphia: The Franklin Institute, Mar 1869), 145ff.

[179] With three sluice gates for each turbine's flume, there were nine gates in all and nine hand wheels along the balustrade overlooking the Forebay.

diameter. Each rotor (the moveable wheel within) was 10 feet, 3 inches in diameter with "buckets" 17 inches deep[180] and 21 inches wide,[181] compared with the rotors in the New Mill House turbines which were 9 feet in diameter and featured buckets 32 inches wide and 12 inches deep.[182] Each rotor contained 49 buckets. The vertical shaft was 16 feet long and 10 inches in diameter. The lower end of the shaft rested and rotated upon a 17-inch-diameter bearing of lignum vitae which was oriented with grain end-on and cooled with a stream of water. The assembly of the moveable wheel, shaft, and attached horizontal bevel gear weighed 18½ tons.[183]

At the tail race was a hinged drop gate that could be raised to close the wheel pit if the turbine needed to be worked on. Water in the pit was then pumped out using a small turbine nine ienches in diameter. Water to drive this turbine was supplied by a pipe connected to an ascending main.

By means of the vertical shaft, the turbine's rotor turned a horizontal iron bevel gear 5 feet, 6 inches in diameter atop the nacelle. This horizontal gear turned a vertical, wood-toothed, 8-foot-diameter bevel gear. The 45-degree-angle interface between the two gears was 18 inches wide. This changed the rotational movement 90 degrees. The vertical bevel gear drove, by a horizontal connecting shaft, a 5-foot, 26-inch-diameter gear. In order to reduce the rotational speed, this gear then drove a gear 10 feet, 26 inches in diameter.

The reduction gears drove a horizontal shaft that spanned the width of the wheel pit over the top edge of the turbine; this long horizontal shaft rotated two large discs, on either side of the

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[180] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 5. In the Annual Report for 1868 Graff claims the turbine is the largest of its kind in America at the time.
[181] "Fairmount Water Works—New Wheels and Pumps," *Journal of the Franklin Institute,* Vol. LVII, No. 3 (Philadelphia: The Franklin Institute, Mar 1869), 145.
[182] "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 270.
[183] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 126.

turbine. Each disc was connected to the cast iron drive shaft for a pump. There was one pump on either side of each turbine. Each drive shaft assembly was 25 feet, 6 inches long and 18 inches at its widest point.[184] This changed the rotational movement to reciprocal (back-and-forth) movement. With a 6-foot stroke, the drive shaft pushed a 22-inch-wide piston within a horizontal, double-acting pump. As with the turbines, the pumps were larger than their New Mill House counterparts which had 18-inch-wide pistons.

Each pump drew water from its side of a flume through two rectangular intakes. In order to minimize water hammer, the highly destructive pressure spikes inherent in reciprocal pumping, each of the two valve chests featured three valves of different sizes. This ensured that none of the valves would open and close at exactly the same time. As a further defense against water hammer, above each pump's two valve chests was a cylindrical air chamber (today called an accumulator), 7 feet high and 3½ feet in diameter. Where a pump's two discharge pipes joined to form a single 23-inch discharge main, a third air chamber was positioned, this one 10 feet high and 4 feet in diameter.

Each pump's 23-inch discharge main converged with its twin from the other side of the turbine's flume into a single 36-inch main. Each of the three 36-inch mains penetrated the rear wall of the Old Mill House and crossed the Forebay.

Unlike those from the breast wheels, the new discharge mains were too large to lie across the bottom of the Forebay without obstructing the flow of water, so they were instead suspended approximately 9 feet above the water's surface. The main from the northern turbine crossed the Forebay along the southern side of the Forebay Bridge, just outboard of the parapet, atop the bridge's piers which were modified for the purpose. The mains from the central and southern

[184] Narrow wrought iron rods on either side of the drive shaft were held in tension and contributed to the rigidity of the shaft assembly.

turbines spanned the Forebay side by side by means of an innovative design Graff created himself, a hybrid approach in which the mains themselves formed the upper compression chord of a bridge truss and linked wrought iron suspension bars formed the lower tension chord. In other words, the pipes were integral to the structure, forming their own bridge. This allowed the two mains to cross the Forebay in a single span without the need for intermediate support piers situated in the Forebay. The suspension bars were 10 inches wide and 1½ inches thick. The clear span between the abutments of this bridge of mains was 77 feet, 11 inches. Even with a live load, in operational use, the mains deflected only seven sixteenths of an inch.[185]

On the opposite side of the Forebay the discharge mains became ascending mains and rose at about a 43-degree angle to the Fairmount Reservoir. The combined length of each discharge and ascending main was approximately 240 feet apiece. The ascending mains each featured double one-way valves to prevent backflow in the case of leaks or bursting.

The ascending main from the southern turbine discharged directly and solely into the Fairmount Reservoir.[186] The main from the central turbine connected to the base of the Standpipe and the main from the northernmost turbine connected to the base of the Distribution Arch; the second and third turbines were thus able to throw water to either the Fairmount or Corinthian Avenue Reservoirs, depending on operational necessity at any given time.[187]

The turbines provided a significant increase in performance. The total output of the Fairmount Water Works increased nearly 23 percent over the output prior to conversion of the Old Mill House from breast wheels.[188]

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[185] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 6.
[186] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 8; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7.
[187] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 7.
[188] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 39.

The total cost of the conversion came to $415,591.[189] In 1863 Cassin had estimated the work would cost $112,000; Birkinbine estimated $200,000 in 1864. Neither, however, had included the cost of the ascending mains in their projections. Whereas each New Mill House turbine cost $7,800,[190] the larger Old Mill House turbines each cost an average of a little over $52,600 apiece.[191] Table 7-1 shows a breakdown of the cost of the Old Mill House reconfiguration project. Table 7-2 compares the dimensions and unit costs of the three turbine designs employed at Fairmount.

Table 7-1. Cost of Old Mill House Conversion to Turbines.

	Phase 1	***Phase 2***	***Phase 3***	***Totals by Year***
1867	$31,260	—	—	$31,260
1868	$86,434	—	—	$86,434
1869	$7,229	$125,873	—	$133,102
1870	—	$13,932	$59,921	$73,853
1871	$5,609	$189	$56,387	$62,185
1872	—	$41	$28,734	$28,740
Totals by phase	$130,532	$140,035	$145,024	
GRAND TOTAL				$415,591

[189] The cost accounting is split between six annual reports. See Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 62; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 59f; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 51, 62f; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 70, 77f; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 68, 71f, 75f; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 91, 94f. The amount was tgeh equivalent of approximately $10.1 million in 2022.

[190] The equivalent of approximately $228,700 in 2022.

[191] In order of installation the three turbines cost $53,000, $52,500, and $52,400, respectively. As with the total cost, the accounting for the three turbines is split between six annual reports. See Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 62; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 59; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 51, 62; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 70, 77; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 75; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 94. The average was the equivalent of approximately $1.3 million in 2022.

Table 7-2. Comparison of Turbines Installed at the Fairmount Water Works.

	Test Turbine	***New Mill House***	***Old Mill House***
Began operations	1851	1862	1869–1871
Ceased operations	1909	1909	1909
Rotor diameter	7 ft.	9 ft.	10 ft., 3 in.
Rotor depth	10 in.	12 in.	17 in.
Rotor bucket width	13 in.	32 in.	21 in.
Pump diameter	16 in.	18 in.	22 in.
Pump stroke	6 ft.	6 ft.	6 ft.
Cost of turbine alone	$8,490	$7,800	~$52,633

unt Water Works Wheel History.

Breast Wheel or Turbine	***Location***	***Date Operational***	***Original Material***	***Dimensions***	***Date Replaced***	***Replacement Material***	***Dimensions***	***Date Removed***
breast wheel	OMH	1 Jul 1822[b]	wood, with iron shaft[b]	15 ft. diameter 15 ft. wide[b]	15 Jul 1846[c]	wood, with iron shaft[d]	15 ft. diameter 15 ft. wide[e]	1883[y]
breast wheel	OMH	14 Sep 1822[b]	wood, with iron shaft[b]	16 ft. diameter 15 ft. wide[b]	15 Jul 1846[c]	wood, with iron shaft[d]	16 ft. diameter 15 ft. wide[e]	1868[z]
breast wheel	OMH	24 Dec 1822[b]	wood, with iron shaft[b]	16 ft. diameter 15 ft. wide[b]	27 Aug 1846[c]	wood, with iron shaft[d]	16 ft. diameter 15 ft. wide[e]	1868[z]
breast wheel	OMH	10 Nov 1827[f]	cast iron, with wood buckets[g]	18 ft. diameter 15 ft. wide[e]	not replaced	NA	NA	1869[a′]
breast wheel	OMH	5 Apr 1832[h]	cast iron, with wood buckets[g]	18 ft. diameter 15 ft. wide[e]	not replaced	NA	NA	1869[a′]
breast wheel	OMH	5 Nov 1834[h,i]	cast iron, with wood buckets[g]	16 ft. diameter 15 ft. wide[e]	1860[j]	unconfirmed; likely same as original	unconfirmed; likely same as original	1870[b′]
breast wheel	OMH	24 Aug 1843[l]	cast iron, with wood buckets[g]	18 ft. diameter 15 ft. wide[e]	186[k]	unconfirmed; likely same as original	unconfirmed; likely same as original	1870[b′]
breast wheel	OMH	24 Aug 1843[l]	cast iron, with wood buckets[g]	18 ft. diameter 15 ft. wide[e]	186[k]	unconfirmed; likely same as original	unconfirmed; likely same as original	1874[c′]
turbine	test pit[m]	16 Dec 1851[d]	cast iron & wrought iron[n]	7 ft. diameter, buckets 10-in. deep &13-in. wide[o]	NA	NA	NA	NA[d′]
turbine	NMH	Jun 1862[p]	cast iron & wrought iron[q]	9 ft. diameter[r] buckets 12-in. deep & 32-in. wide[s]	NA	NA	NA	1911[e′]
turbine	NMH	Jun 1862[p]	cast iron & wrought iron[q]	9 ft. diameter[r] buckets 12-in. deep & 32-in. wide[s]	NA	NA	NA	1911 [e′]
turbine	NMH	Jun 1862[p]	cast iron & wrought iron[q]	9 ft. diameter[r] buckets 12-in. deep & 32-in. wide[s]	NA	NA	NA	1911 [e′]
turbine	OMH	17 Feb 1869[t]	cast iron & wrought iron[q]	10 ft. 3 in. diameter[r,u] buckets 17-in. deep[r,u] & 21-in. wide[w]	NA	NA	NA	1911 [e′]
turbine	OMH	20 Jun 1870[v]	cast iron & wrought iron[q]	10 ft. 3 in. diameter[r,u] buckets 17-in. deep[r,u] & 21-in. wide[w]	NA	NA	NA	1911 [e′]
turbine	OMH	14 Dec 1871[x]	cast iron & wrought iron[q]	10 ft. 3 in. diameter[r,u] buckets 17-in. deep[r,u] & 21-in. wide[w]	NA	NA	NA	1911 [e′]

a. After the reconstruction of the Old Mill House was completed, the wheels renumbered, around 1872.

b. Watering Committee, *1822 Annual Report* (9 Jan 1823), 10f; Watering Committee, *1849 Annual Report* (3 Jan 1850), 29; Watering Committee, *1852 Annual Report* (6 Jan 1853), 33. The 1822 Annual Report provides dimensions and operational dates. All three were of wood construction with iron shafts.

c. Watering Committee, *1846 Annual Report* (14 Jan 1847), 6. (Watering Committee, *1849 Annual Report,* (3 Jan 1850), chart at 28, *Statistics Relating to Fairmount Water Works,* and Watering Committee, *1852 Annual Report* (6 Jan 1853), 48, both indicate all three replacement wheels began operating 14 Jul 1846.)

d. Wood construction with iron shafts. Watering Committee, *1852 Annual Report* (6 Jan 1853), 32; Water Department, *1875 Annual Report* (6 Apr 1876), 24.

e. Watering Committee, *1852 Annual Report* (6 Jan 1853), 32f; Water Department, *1875 Annual Report* (6 Apr 1876), table at 24, *Dimensions of Wheels and Pumps at Fairmount*.

f. Watering Committee, *1827 Annual Report* (10 Jan 1828), 5, and Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28, *Statistics Relating to Fairmount Water Works*.

g. Cast iron with wood buckets. Each wheel weighed 22 tons. Water Department, *1875 Annual Report* (6 Apr 1876), 24.

h. Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28, *Statistics Relating to Fairmount Water Works*.

i. Watering Committee, *1834 Annual Report* (22 Jan 1835), 4.

j. Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 58.

k. Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 20.

l. Watering Committee, *1843 Annual Report* (4 Jan 1844), 5, and Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28, *Statistics Relating to Fairmount Water Works*.

m. The turbine was installed in the waste flume between the north side of the Engine House and south side of the Old Mill House. (Until this time, the waste flume had been used to temporarily drain the Forebay for periodic removal of built-up sediment.) What had been an exterior space was enclosed to form an interior space for the turbine. It was not an easy fit; a cut was made in the formerly exterior south wall of the Mill House to accommodate a flywheel for the turbine. The pump set was placed in a new room constructed for it on the lower level of the river side of the Engine House, in what had been the northern reach of the Esplanade. A new river wall (the third and last river wall constructed for the Engine House) and roof were constructed to enclose this space as well. (The river wall was rebuilt in place in 1874 and the original sloped roof was replaced at the same time with a flat deck supported by Phoenix Columns.)

n. Cast iron housing with wrought iron vanes. Watering Committee, *1854 Annual Report* (19 Apr 1855), 6f.

o. Watering Committee, *1852 Annual Report,* (6 Jan 1853), 32; *1875 Annual Report,* (6 Apr 1876), table at 24, *Dimensions of Wheels and Pumps at Fairmount.*

p. Water Department, *1862 Annual Report* (5 Feb 1863), 14.

q. Cast iron housing with wrought iron vanes. Henry P.M. Birkinbine, Chief Engineer, Philadelphia Water Department, *The Future Water Supply of Philadelphia* (15 May 1878), 1ff, collected in *Report of the Committee on Water Supply* (3 Feb 1885); Watering Committee, *1860 Annual Report* (21 Feb 1861), 46.

r. Frederic Graff, Jr., *Notebooks*.

s. "Turbines at the Philadelphia Water Works, 27 Apr 1866," *Engineering,* Vol. I, Jan–Jul 1866 (London: 1866), 269.

t. Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 5.

u. Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 5.

v. Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5.

w. "Fairmount Water Works—New Wheels and Pumps," *Journal of the Franklin Institute,* Vol. LVII, No. 3 (Mar 1869), 145.

x. Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 6.

y. Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 98. Wheel No. 1 (renumbered Wheel No. 2) ceased operation in 1872 and was removed in 1883.

z. Reconstruction of the southern portion of the Old Mill House began Oct 1867. Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 7.

a′. Reconstruction of the central portion of the Old Mill House began in early 1870. Water Department, Chief Engineer's *1870 Annual Report* (16 Feb 1871), 5.

b′. Reconstruction of the northern portion of the Old Mill House began in Jun 1870. Water Department, Chief Engineer's *1870 Annual Report* (16 Feb 1871), 5.

c′. Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12. The Annual Report for 1873 states the wheel "is being removed" at the time the report is being written, while the Annual Report for 1874 states that it has now been "removed…preparatory for replacing a new turbine." Taken together, these two sources indicate the wheel was removed during 1874. A turbine was suggested as a replacement for the breast wheel, but this recommendation was never implemented.

d′. After the turbines in the Old Mill House and New Mill House ceased operation, the test turbine (Renumbered Wheel No. 1) continued to serve a single industrial customer until it was shut down on 16 Mar 1911. The remains of this turbine and its pump set may still be seen today at the Fairmount Water Works within the Fairmount Water Works Interpretive Center. Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 57; Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 36.

e′. All six of the turbines in the Old Mill House and New Mill House ceased operation on 18 Feb 1909; these turbines and their associated pump sets were removed and sold for scrap from Nov 1911 to Feb 1912. Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 48, 57; William E. Meehan, Superintendent, Fairmount Park Aquarium, to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 36; Fred C. Dunlap, Chief of Bureau of Water, to Rudolph Blankenburg, Mayor of the City of Philadelphia (21 Feb 1912).

As the reconfiguration of the Old Mill House was wrapping up, the two remaining breast wheels remained in terrible condition. The one at the north end had deteriorated to the point that it was irreparable. Graff recommended it be replaced with a small turbine as soon as possible[192] and drafted plans for doing so without the need for extensive remodeling of the building.[193] He had already made provision for connecting this turbine's pump to the new discharge mains.[194] Graff's successor, William H. McFadden, removed the wheel in 1874 and recommended installing in its place a turbine with an 18-inch pump which he calculated would add 2.5 million gallons per day to Fairmount's capacity.[195] Unlike the northern breast wheel, Graff judged the one at the south end to be salvageable. Although he had earlier recommended replacing it with a small turbine,[196] he now recommended refurbishing it.[197] It continued, however, to sit derelict.

A mayoral commission which met in 1875 to examine the city's water supply recommended installing a small turbine in each of the two remaining breast wheel locations and estimated the total cost would be $70,000.[198] The southern breast wheel and its pump were removed in 1883 and the components were sold. Nothing was installed in its place at the time.[199] The Chief Engineer after McFadden, William Ludlow, thought installing a small turbine in the space of Wheel 2 was a good idea but placed it far down on the priority list.[200] Ludlow's

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[192] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 6.
[193] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 6.
[194] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 6.
[195] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12, 28. The Annual Report for 1873 states the wheel "is being removed" at the time the report is being written, while the Annual Report for 1874 states that it has now been "removed…preparatory for replacing a new turbine." This indicates the wheel was removed during 1874.
[196] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 5. Graff had recommended replacing both remaining breast wheels with small turbines.
[197] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 6.
[198] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 47. The amount was the equivalent of approximately $1.9 million in 2022.
[199] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10.
[200] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 13.

successor, John L. Ogden, in 1889 recommended installing a turbine with a single pump in each of the two empty bays, so that in the event the turbines in the Old Mill House were being repaired during a time of plentiful water some pumping could take place there.[201] In the end, however, no turbine was ever installed in either location.

With six of the eight original breast wheels in the Old Mill House now replaced by three turbines and the remaining two breast wheels abandoned, the entire arrangement was given a new numbering scheme. Wheel 9, the original 1851 "test turbine," as it is often called today, located in the space between the Engine House and the Old Mill House,[202] became Wheel 1. The remaining breast wheel at the south end of the Old Mill House (originally Wheel 1) became Wheel 2. The three turbines in the Old Mill House became Wheels 3, 4, and 5 (from south to north, respectively). The remaining breast wheel at the north end of the Old Mill House (originally Wheel 8) became Wheel 6. The three turbines in the New Mill House became Wheels No. 7, 8, and 9 (from east to west, respectively).[203] Table 7-3 shows a comprehensive comparison of all of Fairmount's breast wheels and turbines.

With his 1872 Annual Report, published in January 1873, Graff made no additional proposals for further expansion of water power at Fairmount.[204]

At the same time that Graff was reconstructing the Old Mill House section by section and installing the new turbines and pumps, he was taking steps to ensure the stability of Fairmount Dam. Since 96 percent of the city's water supply was drawn from the pool behind the dam at the time,[205] the structure was the foundational element of the entire system. When Graff became

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[201] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 126, 141.
[202] *Journal of the Select Council of the City of Philadelphia: From January 1, to July 1, 1867,* Appendix 259 (Philadelphia: 1867), 785.
[203] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 7f.
[204] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 6.
[205] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), table at 39. Table lists the amount of water pumped by each of the stations from 1854 to 1873.

Chief Engineer again in 1867 he found he had to shore up the dam in a virtual replay of what Birkinbine had to do in 1864 and 1865.[206] Rock fill had again washed out of the wood structure in multiple places and without the support of the fill some of the timbers were sagging. The rock had to be replaced and the timbers renewed.[207] Minimal as it was, the work was difficult, lasting three construction seasons and costing $5,380.[208] It was literally stop-gap, however, until the dam could be secured in a more lasting fashion.

With the third turbine and pump set becoming operational in the reconstructed Old Mill House in December 1871 and final punch list items being completed in early 1872, Graff could devote additional resources to the dam.[209] The overfall portion of the original structure was constructed with hemlock timbers and rock fill from 1819 to 1821. In 1842 and 1843 the portion from the low water mark up was removed and rebuilt using white pine and rock fill.[210]

Graff's first thought was to construct a new structure immediately against the downstream side of the dam using the cribs sunk in 1864 and 1865 by Birkinbine and renewed at his own direction from 1867 to 1869. Further investigation gave him pause, however. After interviewing employees involved in Birkinbine's work and personally inspecting the cribs, which was difficult because the tops of the cribs were below the level of low tide and the bases of some of them were nineteen and twenty feet below that, Graff concluded that the newer cribs were not substantial enough to form a foundation for a new structure.[211]

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[206] Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 18; Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11f.
[207] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 5f.
[208] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 66; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 65; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 55. The amount was the equivalent of approximately $117,200 in 2022.
[209] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 7ff; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6f.
[210] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9.
[211] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 6.

Graff considered removing the recent cribs but decided it would be too difficult and would risk damaging the dam itself.[212] He chose instead to build an entirely new structure, upon the bedrock, 38 feet downstream of the original dam.[213] The recent cribs would remain in place between the old structure and the new. This would widen and strengthen the overall structure. The new overfall would in fact be approximately 60 feet downstream of the old.[214] Constructing a new structure would have the added benefit of needing only a relatively small and light cofferdam situated atop the comb of the dam instead of the extensive and heavy cofferdams employed in the 1842 reconstruction.[215]

The work began on 1 Jun 1872.[216] On the western end, Graff sank a line of gabion cribs directly in front of the original dam. In the deepest part of the river, in the central area and eastern end, where Birkinbine had sunk cribs in 1865, Graff sank two lines of cribs, one atop Birkinbine's cribs and one in front. Thirty feet of Birkinbine's cribbing at the far eastern end turned out to be resting on loose material, however, and was not secure. This portion was removed and replaced with new cribs sunk all the way to the underlying bedrock.

White pine was used for the wood structure of the gabion cribs and white oak for the decking. The rock fill was excavated from a location in Fairmount Park on the west side of the river where a roadway was planned, thereby saving money and killing two birds with one stone. Gillingham & Garrison, a shipbuilding supplier located along the Aramingo Canal (also called

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[212] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 7.
[213] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 7; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 7ff.
[214] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 7.
[215] This turned out to be a wise choice when in the fall of 1872 two freshets carried away the cofferdam and set construction back a month. Use of the previous cofferdam arrangement would have resulted in a much longer delay. See Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 8.
[216] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 7.

Gunnar's Run) in the Port Richmond neighborhood,[217] provided the pine; the oak was acquired from Daniel Williams & Sons. Wharf builder William Taxes was the general contractor. Robert N. Bowers, the Water Department's General Superintendent in charge of Fairmount Dam, served as the onsite supervisor during 1872; George W. Hutchinson replaced Bowers the following year.[218]

While construction was halted for the winter, so much ice accumulated behind the dam that it blocked the flow of water. The worrisome condition persisted for two months and caused concern about the safety of the partially renovated dam, but the structure held.[219] Construction on the dam was completed in 1873 after William H. McFadden followed Graff as Chief Engineer.[220] McFadden finished the dam as Graff had designed, with one alteration. Earthen fill had been planned to be placed in the space between the old and new structures, but McFadden changed this to concrete.[221]

The widening of the overfall portion of Fairmount Dam in 1872 and 1873 made lengthening the Pier necessary. Recall that the entire system of the dam consisted (from west to

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[217] Leland M. Williamson et al., eds., *Prominent and Progressive Pennsylvanians of the Nineteenth Century*, Vol. III (Philadelphia: Record Publishing Co., 1898), 135ff; Pennsylvania Department of Transportation (PennDOT), "Maps Gallery: Aramingo Canal," *Digging I-95* (11 Nov 2014), <https://diggingi95.com/images/aramingo-canal-historic-maps-figures-gallery/>, accessed 1 Apr 2020.

[218] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 3, 8f; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 3, 7.

[219] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 7.

[220] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6. Although McFadden reports that work on the dam was completed in 1873, costs for construction (labor, materials, etc.) were accounted for in the annual reports for 1874 and 1875. See Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 70; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 101.

[221] This was the Water Department's specification, at any rate. Apparently based upon this, the Annual Report for 1895 also states, "The present structure consists, properly speaking, of two dams, one constructed in 1819–21 and enlarged in 1842–43, the other built in 1872, a few feet below the first. The space between the two is filled with concrete." In 1904, however, during work to repair serious damage to the downstream structure of the dam, sustained during flooding in February of that year, it was discovered that the space between the two structures had in fact been filled with earth and only a relatively thin veneer of concrete had been laid on the surface. With the pounding of water and ice over time, this unauthorized substitution broke apart and contributed, by 1904, to the compromising of the integrity of the lower structure. See Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6; Bureau of Water, *Chief Engineer's 1895 Annual Report* (6 Apr 1896), 128; Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 83.

east) of the structures of the Schuylkill Navigation system, the overfall structure, Pier, Mound Dam with embedded New Mill House, and Old Mill House. The purpose of the heavy stone Pier was to serve as an anchoring point between the eastern end of the overfall structure and the Mound Dam. When the overfall structure was a narrow line of cribs, the Pier when viewed from above was nearly square. With the overfall structure widened, the face of the dam was now approximately 60 feet further downstream; the Pier needed to be lengthened toward the downstream side in order to continue to serve as the overfall structure's eastern anchor. From above, the new plan of the Pier would be a long, narrow rectangle perpendicular to the line of the dam.

Like the work on the overfall, alteration of the Pier began in 1872 and was completed the next year. The area immediately downstream of the original Pier structure was cleared of loose stones and mud all the down to bedrock, up to 24 feet, 9 inches below the level of low tide. Part of the clearing was done by dredging, but some of it was done by "submarine divers"[222] working by hand. For the foundation a wood crib filled with crushed rock was sunk to the bedrock and allowed to compact over the winter. In the spring of 1873 stone masonry was built atop the foundation to the level of the original Pier.[223] Including the modification to the Pier, the total cost of the renovation and renewal of Fairmount Dam was $220,761.[224]

In 1874 the top of the Mound Dam between the New Mill House and the Pier was raised eight inches and paved with flagstones. Steps were constructed down to the downstream side of the base of the Mound Dam and the iron balustrade of the deck of the New Mill House was

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222 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5.
223 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 5f; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6.
224 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 90, 98; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 89f; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 70; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 101. The amount was the equivalent of approximately $5.4 million in 2022.

extended along the downstream side of the promenade atop its crest and around the perimeter of the lengthened Pier.[225]

[225] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12f.

CHAPTER 8

FAIRMOUNT WATER WORKS AT ITS ZENITH

With the completion of the transition to turbines and the renovation of Fairmount Dam, the Fairmount Water Works entered a period which the casual observer of history might consider to be a second golden age. Output was high and growing, the number of gallons of water needed to pump a gallon to the Fairmount and Corinthian Avenue Reservoirs had been reduced, and despite the presence of steam-powered pumping stations on the Schuylkill and Delaware Rivers,[1] the percentage that Fairmount contributed to the overall supply was still commanding. Even though the turbines weren't as dramatic in their operation as the breast wheels had been, people still came to see them work. Visitors continued to flock to the grounds on pleasant summer days.

The seeds of Fairmount's decline, however, were already being sown. The most serious had to do with the very nature of Fairmount's system itself—the use of water to pump water.

Up to this point, we have been following the history of the Fairmount Water Works in rather close chronological order. In this chapter, we will back up a bit in order to follow a few threads so we may explore some of the challenges Fairmount was already facing and discover how these combined to affect its future.

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As the Old Mill House was transitioning to turbines, an ominous sign appeared for

[1] The pumping stations operating in 1873 were the Schuylkill, Roxborough, and Belmont Works on the Schuylkill River, the Delaware Works on the Delaware River, and the Chestnut Hill Works on a spring in the Chestnut Hill neighborhood. See Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 30ff.

anyone who had could recognize it. Encountered in 1871, it involved a legal dispute, once again, over the relationship between the City of Philadelphia and the Schuylkill Navigation Company.

Recall that in 1824 the City believed it had purchased from the canal company the possession of the locks and canal at the western end of the Fairmount Dam and all of the water rights at Fairmount except what was necessary to operate the locks and navigation system. In 1832 and 1833, however, officers of the canal company had intimidated their way into retaking possession of the locks and canal. Lawyers for the canal company had argued at the time that its original 1815 charter, granted by the state legislature, made its right of the use of the Schuylkill River for navigation absolute and preeminent to all other rights by any other party. Neither a lawsuit nor negotiations by the City upended that opinion and it became the accepted state of affairs by all concerned.

Thirty-six years later, from August to October of 1869, the area experienced the longest and most severe drought it had seen since Fairmount Dam was built in 1822.[2] Although water conservation efforts by ordinary citizens helped somewhat, there was a genuine danger of a significant water shortage.[3] At the time, the Schuylkill River supplied over 91 percent of the city's water supply. During the drought, the city needed to obtain every gallon of water it could from the Schuylkill River and Graff was forced to draw down the water in the Fairmount Pool below the top of the dam.[4] From 11 Aug to 7 Sep the water level in the Fairmount Pool stayed below the level of the dam and from 14 Aug to 7 Sep it was even too low for navigation in the canal.[5]

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[2] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 6f.
[3] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 6.
[4] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 7.
[5] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania*, October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 111.

In mid-August, the Schuylkill Navigation Company and the City of Philadelphia communicated with each other regarding the crisis. In a letter on 7 Aug 1869 the Secretary of the canal company warned Graff that he was drawing water down to the point that navigation in the canal was being hindered. The Secretary urged the City of Philadelphia to install additional steam engines instead of relying on water power. This was preferable to legal action, he said, since the canal company knew the City was acting in good faith.[6]

Four days later the Secretary sent Mayor Daniel M. Fox a letter, with a copy of the letter to Graff enclosed, notifying the City that all navigation on the canal had stopped due to the drawdown of water. The Secretary pointed out that the legal issue wasn't the City's use of water for consumption but for power. He explained that although it was illegal for the City to use water for power beyond the point at which it hindered navigation, and doing so would incur "heavy liability to all injured," the managers of the company were allowing the City to draw water to "supply power to its machinery at the Fairmount waterworks [*sic*] for a short time longer."[7]

The same day a committee of officers of the canal company met with the mayor to plead for the suspension of pumping at Fairmount. Mayor Fox responded that he would resist any attempt to shut down the Fairmount Water Works, using the police force if necessary.[8] With Fairmount contributing over 60 percent of the crucial Schuylkill River supply, the city could

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[6] Secretary of the Schuylkill Navigation Company to Graff, 7 Aug 1869, quoted in "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 108f.
[7] Secretary of the Schuylkill Navigation Company to Fox, 11 Aug 1869, quoted in "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 109f.
[8] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 111.

hardly afford to do without it.[9]

On 14 Aug Graff wrote to the Assistant President of the Schuylkill Navigation Company that "the supply in our reservoirs is so low as greatly to imperil not only the comfort but the safety of the city" and implored the company to close its locks at Fairmount and open the dams at the top of the Fairmount Pool until the crisis passed. He expressed confidence that the City would "do full justice" to the company.[10] In other words, acting for the City of Philadelphia, Graff was assuming responsibility.

The canal company's Assistant President immediately responded to Graff, writing that the Schuylkill Navigation Company would do as he requested and trust the City to indemnify it against all losses and liabilities which would result.[11] The two parties coordinated their efforts. Graff had flashboards installed along the top of Fairmount Dam so that when the canal company opened its sluiceways at Manayunk, extra water would at least temporarily be contained in the Fairmount Pool.[12]

The amenability of the canal company may seem surprising when the history of its relationship with the City of Philadelphia is considered. Perhaps it was equal parts magnanimity during a desperate time and a practical recognition of a potential public relations nightmare in

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[9] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), tables at 17, 19, 21, 13, 25. At this time, the Schuylkill River provided 91.6% of the city's supply of water. Of the water pumped from the Schuylkill, Fairmount contributed 65.9%; Fairmount's share of the total supply was 60.3%.

[10] Graff to Charles W. Wharton, 14 Aug 1869, quoted in "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 110.

[11] Charles W. Wharton to Graff, 14 Aug 1869, quoted in "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 110f.

[12] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107. It seems that this coordinated action took place on 7 Sep 1869. The record shows that navigation resumed on the canal at that date even though no rain fell through October to raise the water to a navigable level. See "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 126.

which the great majority of citizens would neither understand nor care about the finer points of 36-year-old precedent legal decisions when there was a water shortage affecting their own livelihoods. In any event, the managers of the Schuylkill Navigation Company decided that during the drought they were going to allow the City to draw as much water from the Schuylkill River as it needed and let it reap the consequences later.

On 23 Aug 1869 Mayor Fox sent a special message to City Councils in which he straightforwardly stated:

> The recent drought has been of unusual length, and the result has been that our water department under the pressure of the public necessity, and to avoid the horrors of a water famine, assuming responsibility in a manner which I fully approve, has been compelled, first, to take water-power to which it would seem to have no right, to the great injury, as it is alleged, of the parties thus deprived of it; and finally, when that resource was exhausted, to solicit, receive and day after day be wholly dependent upon further supplies of water-power voluntarily furnished by those very parties.
>
> …Compensation for any loss sustained by our compulsory stoppage of loaded boats, seems to be due as a simple measure of justice, outside of the question of legal liability.[13]

The mayor went on to commend the officers of the Schuylkill Navigation Company for "voluntarily coming to our rescue in the hour of our utmost need…." The company's officers, he reminded Councils,

> …did not in this instance pause to consider the legal aspects of the case, but…at once closed their locks, drew down their dams and trusted everything to our honor. Upon that faith in us they may sustain heavy losses of revenue, whilst we have received great benefit.

[13] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107f.

> I therefore cannot doubt that councils will without delay make such provision as will fully indemnify the company for whatever losses they may have sustained in thus furnishing the needful supply to the city in her extremity.[14]

Shortly after, Councils appropriated $25,000[15] to the Water Department to pay any claims for damages by the canal company.[16]

In November, however, the City of Philadelphia was sued in district court, not by the Schuylkill Navigation Company but by a canal boatman named Henry Collins.[17] Because of the low water, Collins and his boat had been stranded in the Manayunk Reach of the canal from 10 Aug to 7 Sep, along with the captain, a steersman, a driver, a load of coal, and two mules. Collins was suing for damages.[18]

Collins and his counsel presented into evidence the communication exchanged between the Schuylkill Navigation Company and the City of Philadelphia, as well as the mayor's message to City Councils.[19] Providing technical details, Graff testified that the City of Philadelphia had drawn water below the legal limit and had been allowed to do so by the Schuylkill Navigation

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[14] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 108.

[15] The equivalent of approximately $565,200 in 2022.

[16] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 51; "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106, 112, 124.

[17] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106.

[18] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106f.

[19] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107f.

Company.[20] On 2 Jun 1870 the jury found for the plaintiff and awarded Collins $275.[21] To prevent a precedent from being set, the City appealed the decision to the Pennsylvania Supreme Court,[22] but on 8 May 1871 the high court upheld the lower court's decision.[23]

The state Supreme Court determined that the key issue was not the City's drawing of water for consumption but the drawing of water for power.[24] According to the court, the City could have, under the principle of "paramount necessity," drawn as much water as it needed for public consumption (presumably using steam power).[25] The issue was the use of water for power until the level in the Fairmount Pool was drawn down to the point that navigation was impeded.

The court found that the City of Philadelphia was liable for damages because it did what it had no legal right to do.[26] The court further determined that the Schuylkill Navigation

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[20] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107. Testimony was also given that the average daily amount of water used for power by the Fairmount Water Works was estimated to be the equivalent of between 8½ and 11 times the amount needed for forty boats to pass through the locks at Fairmount each day. This testimony was provided by highly respected and experienced civil engineer John C. Trautwine, whose son, John C. Trautwine, Jr., would twenty-five years later be appointed Chief Engineer of the Bureau of Water (renamed from Water Department). See "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 125; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 42, 63.

[21] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 118. The amount was the equivalent of approximately $6,217 in 2022.

[22] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 118.

[23] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 126.

[24] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106, 121f.

[25] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 123.

[26] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 123.

Company, by the terms of its own charter, had no legal right to grant the City permission.[27] In other words, both parties were at fault.[28] However, since the City of Philadelphia was the only party sued in the case, the court had no choice but to find liability with the City alone.

The court determined that if the City had drawn all the water it needed by steam power alone, the Fairmount Pool would not have been drawn down below the level of navigability.[29] The court also held that the City of Philadelphia ought to have had machinery which would not have been so wasteful of water, especially seeing that it knew that water for power was prohibited if it harmed navigation. In other words, as the court put it, "No one can allege a neglect as an excuse for an injury."[30] Additionally, the court saw the $25,000 which City Councils appropriated to the Water Department as a *de facto* recognition by the City of its liability.[31]

A few questions spring to mind. Although we can't know the answers for certain, we can venture a few educated speculations.

Why didn't Collins also sue the Schuylkill Navigation Company if he knew it had given the City of Philadelphia permission to draw down the water level to the point that it harmed its own interest and that of the boatmen? He may have realized that he had to maintain a working

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[27] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106, 121.

[28] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106.

[29] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 124f.

[30] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106, 125.

[31] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 106, 124.

relationship with the canal company afterward, but had no such relationship to protect with the Water Department.

Why didn't the Schuylkill Navigation Company simply pay Collins out of the $25,000 the City of Philadelphia had already given it? Councils gave the $25,000 to the Water Department; it is unclear whether the Department paid any of this sum to the canal company or merely kept it in reserve.[32] Alternatively, the canal company may itself have been in financial straits because of the drought and scraped for every penny. Perhaps its officers thought paying Collins would be appear to be an admission of liability and would attract numerous lawsuits from other boatmen. Perhaps the canal company had already attempted to do so but Collins decided its offer wasn't enough to cover his damages.

Why didn't the City of Philadelphia settle out of court and simply pay Collins what he was asking or negotiate a settlement? Like with the canal company, the City may have believed that doing this would invite a flood of similar suits for damages. It might also have thought that doing so would be tantamount to admitting liability and would potentially set a dangerous legal precedent after which it would be constrained against drawing as much water from the Fairmount Pool as it needed in order to meet demand. By defending itself in court, ironically, the latter is exactly what did happen.

Why didn't other boatmen sue the City of Philadelphia for damages? For three reasons, perhaps. First, any payments by the Schuylkill Navigation Company from the $25,000 fund, if they were made, may have been sufficient to cover their damages. Second, while the City was defending itself, a lawsuit was difficult and potentially expensive, and the outcome was not guaranteed. Third, even though the legal process was concluded in Collins' favor, the case was

[32] Since the Annual Report for 1869 does list the $25,000 as an expense, it was likely paid to the canal company. See Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 51.

decided at the supreme court one and a half years after the drought had ended. By that time, other boatmen had either been paid by the Schuylkill Navigation Company from the $25,000 fund or decided it wasn't worth the trouble.

Despite these minor questions, the greater legal question had been settled once and for all, again decisively so. The City of Philadelphia could draw all the water from the Schuylkill it needed for consumption, but could only use water for power if it did not impede navigation. This had significant long-term implications for the Fairmount Water Works. Graff had testified during the trial that he estimated Fairmount's turbines used approximately 13½ gallons to pump one gallon to the reservoirs and its breast wheels used between 22 and 27 gallons.[33] The steam engines used a tiny fraction of that amount. The problem during the drought wasn't simply the drawing of water from the Fairmount Pool, it was the drawing of water to power the system.

What had seemed so great an asset—a water-powered station that pumped water inexpensively, without the need to burn wood or coal—had turned into a liability. There was now both a legal limit as well as a practical limit to the availability of water power on the Schuylkill. Almost immediately there seemed to be at least a tacit understanding of this, a dawning recognition that the future of pumping on the Schuylkill lay not with water power but with other sources of power. After the conversion from breast wheels to turbines was completed in 1871, no further expansion of water power was ever seriously proposed at Fairmount, only improvements in the efficiency of the machinery already in place.[34] With the exception of relatively minor adjustments and modifications to increase the performance of Fairmount's

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[33] "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107.

[34] In 1875 McFadden, Chief Engineer at the time, proposed installing three additional turbines in the western end of the Mound Dam, but evidently thought better of it and never mentioned it again. See Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12.

turbines,[35] all future increases in the pumping capacity on the Schuylkill River would be achieved elsewhere, with steam or electrical power.

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Although the reconfiguration of the Old Mill House consumed an inordinate amount of attention, other problems demanded consideration as well. One such issue was the chronic and worsening shortage of water in the area supplied by the Germantown Water Works, a relatively small, spring-fed distribution system serving a high-level area in the northern Germantown neighborhood. Graff's solution was to build a connecting main from the Roxborough Water Works to Germantown's Mount Airy Reservoir. Where the main needed to cross the Wissahickon Creek valley, Graff designed a large pipe bridge.

Graff based the design on the innovative pipe bridge he had designed to carry the new discharge mains from the reconstructed Old Mill House over the Forebay. Instead of a 77-foot bridge with a single span and an abutment on either end, however, the pipe bridge across the Wissahickon Valley was 660 feet long and featured four spans of 165 feet each, supported by three piers (columns) and an abutment on each end.

Each of the three piers consisted of four Phoenix columns, each 8⅜ inches in diameter. Measuring 7 by 14 feet, each pier was stiffened by cross ties and horizontal wrought iron beams, and rested on a stone base. Atop the piers, the spans crossed the valley 100 feet above the ordinary level of the Wissahickon Creek.

The water was carried in two 20-inch mains, parallel and 14 feet apart on center (roughly

[35] For example Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 15; Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 14.

12 feet between their exterior surfaces). As with the pipe bridge across the Forebay, the mains were integral to the support structure; they formed the top compression chords of the spans. Two sets of wrought iron suspension links for each main formed the bottom chords in tension. The links were each 10 square inches in cross section and attached to lugs cast on the sides of the end pipes of each span. Between the top and bottom chords (the mains and the suspension links), Phoenix columns provided vertical support and stiffening.[36]

Graff provided the preliminary design; a civil engineer named John Murphy completed the final design and led the construction project.[37] Construction began in 1869[38] and finished the following summer;[39] the structure cost $55,905.[40] The sections of connecting main on either side, begun in 1868 and completed in 1871,[41] cost an additional $118,282,[42] bringing the total for entire project to $174,187.[43] It became operational in March 1871.[44] Eighteen months later the Germantown Works were abandoned, after which the reservoir there was filled entirely from the Roxborough Works.[45]

Although the iron mains were intentionally left exposed to winter temperatures, it was

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[36] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 11f; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 12f; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 63; Francis Frith, *Pipe Bridge Over the Wissahickon Creek, Philadelphia, 1870–1891,* albumen print, 26.0cm × 13.6cm, Museum of New Zealand (O.020469).
[37] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 12; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 13.
[38] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 12.
[39] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 12.
[40] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 56; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 72. The amount was the equivalent of approximately $1.3 million in 2022.
[41] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 14; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 11, 70.
[42] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 65f; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 55f; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 72; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 70. In 1868, 1869, 1870, and 1871, $91,278, $22,991, $2,792, and $1,221 were spent, respectively. The total amount spent on connecting mains was the equivalent of approximately $2.9 million in 2022.
[43] The equivalent of approximately $4.2 million in 2022.
[44] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 11.
[45] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 14.

thought that the continuous flow of water through the pipes would provide the necessary protection from freezing, much like an absent homeowner will leave a faucet trickling to prevent the pipes in an unoccupied house from freezing when the heat has been turned off. On 17 Feb 1875, however, less than four years after the pipe bridge began supplying water, one of the pipes froze and burst anyway.[46] Examination showed that the pipe had silted up, slowing the flow of the water enough that it froze and caused the pipe to fail.[47]

By this time William H. McFadden had replaced Graff as Chief Engineer. Instead of repairing the pipe bridge, McFadden decided to replace it with an inverted siphon. Construction began on 17 Nov 1875 and was completed the following spring. Like the pipe bridge, the siphon consisted of two 20-inch mains but they were laid across the bottom of the valley instead of being suspended above it. Operating under a head of 295 feet where the siphon crossed under the bed of the Wissahickon Creek, each of the components was tested to 345 psi. In the end, the siphon cost less than $6,000[48] and proved to be more reliable at keeping the Mount Airy Reservoir filled than the pipe bridge at not much more than one tenth of the cost.[49]

McFadden's decision to use a siphon to cross the Wissahickon may have been influenced by a design choice made by Graff in 1870. Graff and his engineers had decided to supply two of the high wards on the east side of the Schuylkill River, Wards 20 and 28, from the Belmont station on the west side.[50] With construction on the large pipe bridge wrapping up, Graff considered using another pipe bridge design to cross the Schuylkill River but elected to lay a 36-inch main across the bottom of the river instead. A flexible joint design, patented by John R.

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[46] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 40.
[47] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 63.
[48] The equivalent of approximately $166,100 in 2022.
[49] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 62f, diagram at 155.
[50] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 9f, 13f.

Ward of Jersey City, New Jersey, was employed and the submerged main was completed across the river in 1870.[51] Even while the pipe bridge across the Wissahickon was still operating successfully, Graff expressed his satisfaction that the submerged design had been chosen over the pipe bridge option.[52]

The submerged main was trouble-free[53] for twelve years. In December of 1882, however, it developed a leak in one of its joints, but it was in the deepest part of the river (near the east bank) and wasn't detected until January. The main was shut down and repaired in the spring of 1883 but it ruptured again the following December. In the summer of 1884, William Ludlow, Chief Engineer at the time, attempted to have it repaired more effectively using a custom-designed, steam-powered, floating cofferdam fashioned in part from materials recovered from earlier projects.[54]

The floating cofferdam consisted of a four-sided, heavy wood box, open at top and bottom, 31 feet long, 10 feet wide, and 25 feet high. Constructed of 12×12-inch yellow pine beams, it was supported by two boats (repurposed canal boats), one on either side. The box was maneuvered into place and the main was raised by chains. When the main was secured within the box, a moveable "floor," composed of 6×8-inch white pine timbers, was positioned along the bottom with the help of divers and the water was pumped out of the box. The two support boats were partially filled with water. As the water level in the river fluctuated with rain events, the amount of water in the support boats was increased or decreased as necessary to adjust their

[51] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 13f, illustrations at 14. The submerged main crossed the river directly from the Belmont engine house, immediately downstream of the Columbia Railroad Bridge. See Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), diagram at 153, "Plan of Property, Belmont Water Works."
[52] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 13ff.
[53] For example, Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 10.
[54] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 17; Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 11f; Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 17, 174ff, illustration at 177.

buoyancy in order to keep the cofferdam at the proper level above the bottom of the river. Two smaller boats housed equipment and machinery for the divers and a small steam engine, boiler, and pump.

The operation was laborious and required the near-constant coordination of construction crews, repair crews, and divers. It was so effective, however, that it continued to function through two flood events. All of the work was accomplished by Water Department engineers and work crews. The complex cofferdam system was designed by General Superintendent Joseph J. deKinder. The repairs to the main were designed and carried out by John M. Montgomery, the 4th District Purveyor.

When the damaged section of main was raised and exposed, it was discovered that it was in worse shape than had been expected. As a remedy, an over-engineered repair consisting of a replacement length of straight pipe, lead joints, a longitudinal steel rail, and wrought-iron circumferential bands was devised and implemented. The repaired main was lowered onto a new bed of stone and hydraulic concrete installed by divers. Other, less serious leaks were discovered in nearby sections of the main where cracks had developed and they two were repaired.

Such great effort was expended on the submerged connecting main because although it was used to supply areas on the east side of the Schuylkill River only on a supplementary basis from time to time, the extra supply was crucial when needed.[55] In late 1885 it was put into use once more but ruptured again almost as soon as water began to be pumped through it. It was determined that a faulty repair from the year before had failed. Winter temperatures prevented the main from being immediately repaired[56] and in 1886 additional breaks occurred leaving the main in worse condition than before the expensive repairs were made two years prior. John L.

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[55] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 140.
[56] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 140.

Ogden, now Chief Engineer, recognized that surplus power at the Belmont station would go to waste without a connecting main across the river and recommended the existing main be repaired well (already proven to be a difficult prospect), a new submerged main be laid, or a 30-inch main be installed across the Philadelphia & Reading Railroad's Columbia Bridge, just a few yards upstream.[57]

None of the alternatives was implemented, even though the latter could have been accomplished when the original covered wood bridge was replaced by an iron Whipple truss bridge in 1886. This was likely due to subsequent improvement in the pumping capacity at the Schuylkill Works[58] and the completion of the East Park Reservoir in 1889.

During Graff's second tenure, the Fairmount and Corinthian Avenue Reservoirs (the former fed entirely, the latter partially, by the Fairmount Water Works) supplied the entire area of the city south of Vine Street.[59] Graff in 1867 considered removing the partitions between the basins in the Fairmount Reservoir in order to increase its capacity but this was never done.[60] The same year multiple slides along the exterior sodded slopes of the reservoir's embankments required repair.[61]

In 1871, the selection of Penn Square[62] for the site of the new City Hall, and the decision the following year to erect a single large structure across the entire square instead of four separate structures in each of the square's corners,[63] necessitated the displacement of two large

[57] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 10f.
[58] The Schuylkill Works would again be known as the Spring Garden Works by then.
[59] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 32.
[60] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 9.
[61] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 9.
[62] Centre Square was renamed Penn Square by resolution of City Councils on 19 May 1829. See J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. III (Philadelphia: L. H. Everts & Co., 1884), 1844.
[63] Bureau of City Property, *Directory of Philadelphia City Hall* (Philadelphia: Dunlap Printing Co., 1908), 26; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The

supply mains which ran down Broad Street straight under the square. A 30-inch main was diverted around the east side along Juniper Street and a 20-inch main was diverted around the west side along Merrick Street. Each rerouting required 875 feet of additional main plus two quarter-circle curves of 50-foot radius. Although the work caused a significant supply disruption to a large portion of South Philadelphia, the work was performed over the winter of 1872–1873 during the period of lowest demand. The construction was paid for by the Public Building Commission.[64]

Although Graff's attention during his second period as Chief Engineer was consumed with operational demands, he did manage a few improvements to Fairmount's buildings and grounds. In 1866, he had the North Cliffside Path, which he had found to be "so steep as to be dangerous in winter," regraded to a gentler slope. He also widened many of the walkways in the South Garden, relining them with paving bricks.[65]

By 1872, William Rush's *Allegory of the Schuylkill River*[66] was beginning to fall apart. Sculpted of wood and painted white, it had originally graced the eastern lawn of the Centre Square Water Works for approximately twenty years beginning in 1809. Moved around 1829 to the foot of the cliff at the southeast corner of the Fairmount Water Works' Forebay, and still functioning as a fountain 42 years later, the once celebrated figure of a woman holding a water fowl had seen better days.

Recognizing the sculpture's beauty, in addition to its historical value "as a relic of the first works supplying the City with water,"[67] Graff had the work cast in bronze by the Robert

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Pennsylvania State University Press, 1993), 24f. Up to this time, recall, the municipal government was housed at 5th and Chestnut Streets, one of the buildings in the State House (Independence Hall) complex. Because the space was inadequate, however, many municipal functions, such as those of the Water Department, were located elsewhere.

[64] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 15.

[65] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 9.

[66] Often erroneously called "Nymph and Bittern." See Chapter 1 for a discussion of the name.

[67] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9.

Wood & Company foundry.[68] Since the dark bronze of the reproduction wouldn't stand out against the dark-colored rock of the cliff face behind the Forebay, Graff instead placed it in the center of the South Garden's Central Marble Fountain atop a rustic rock-pile base. Jets of water, including one from the bird's bill, created a shower around the figure similar to the original.[69]

The *Boy and Dolphin* fountain, designed by Graff's father, had occupied the Central Marble Fountain since 1835. Graff moved it to the Green Street entrance of the North Garden.[70] After replicating *Allegory of the Schuylkill River* in bronze, Graff placed the original back in its long-time home behind the Forebay where it unfortunately continued to deteriorate.[71]

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Throughout the nineteenth century, the City of Philadelphia pursued a policy of acquiring tracts of land along the Schuylkill River in order to help protect the cleanliness of the Schuylkill River, from which much of the city's water supply was drawn, including by the Fairmount Water Works. The management of these properties as parks was a natural outgrowth of this effort.

Protection of the water supply was the primary reason the City in 1844 had purchased the 52-acre Lemon Hill property, located about a half mile upstream of the Fairmount. At the time Thomas P. Cope, the city's agent for the purchase of Lemon Hill, had proposed that the

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[68] This is the same foundry that in 1848 produced the cast iron fence that surrounds the Graff Memorial. See Watering Committee, *1848 Annual Report* (4 Jan 1849), 16.
[69] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 9f.
[70] J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. III (Philadelphia: L. H. Everts & Co., 1884), 1869.
[71] By 1900 the original sculpture was so badly decayed that was removed from its place at the foot of the cliff behind the Forebay. Only the head survives today, on display at the Pennsylvania Academy of the Fine Arts in Philadelphia. See Henri Marceau, *William Rush: The First Native American Sculptor* (Philadelphia: The Pennsylvania Museum of Art, 1937), 28; "Head of the Nymph (Fragment from *Allegory of the Schuylkill River*)," *Pennsylvania Academy of the Fine Arts* (2020), <www.pafa.org/museum/collection/item/head-nymph-fragment-allegory-schuylkill-river>, accessed 8 Sep 2020.

immediate next step should be the acquisition of some of the low-lying area along the river between Fairmount and Lemon Hill (which became known as the Flat Iron), but the legislation he introduced was tabled in the Common Council.[72] After Graff, Jr. assumed the position of Chief Engineer of the Water Department upon the death of his father in 1847, he advocated for the acquisition of additional land upstream of Fairmount.[73] Prior to Consolidation, Graff floated a plan in 1851 for the development into a public park of a broad strip of land along the east side of the Schuylkill River north from Fairmount. This would not only have included Lemon Hill but also the Sedgeley tract, a bluff-top property between Lemon Hill and the Girard Avenue Bridge to the north, even though the city did not own Sedgeley.[74]

Recall that after City Councils were given the responsibility of developing and managing public parks under the Act of Consolidation in 1854,[75] it responded on 28 Sep 1855 by assuming direct management of Lemon Hill (the City had been leasing it to a food and drink concession operator) and combining it with the grounds of the Fairmount Water Works to create Fairmount Park.[76] In January of the following year Graff again recommended the Lemon Hill property be improved and maintained so "by that means," as he put it, "the shore for a considerable distance, and as far as it is within sight from Fairmount, can be protected from contamination, and from

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[72] Eliza Cope Harrison, *Philadelphia Merchant: The Diary of Thomas P. Cope, 1800–1851* (South Bend, Indiana: Gateway Editions, 1978), 447f.

[73] For example Graff, Jr., to Theodore Cuyler, Esq., Chairman, Committee on City Property, 12 Oct 1857, published in "Fairmount Park," *Public Ledger* (20 Oct 1857).

[74] Frederic Graff, Jr., *Plan of Lemon Hill and Sedgley Park, Fair Mount and Adjoining Property* (15 Oct 1851), map, Park Maps collection, Free Library of Philadelphia, <https://libwww.freelibrary.org/digital/item/65444>, accessed 8 Apr 2020.

[75] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §39 (Harrisburg: Boyd Hamilton, 1854), 42f; "…It shall be the duty of the city councils to obtain by dedication or purchase, within the limits of the said city, and adequate number of squares or other areas of ground, convenient of access to all its inhabitants, and lay out and maintain such squares and areas of ground as open public places, for the health and enjoyment of the people forever."

[76] Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 8; Water Department, *Chief Engineer's 1855 Annual Report* (17 Jan 1856), 5.

the erection of any establishment thereon which might hereafter become a nuisance."[77] In 1857 the city acquired Sedgeley and expanded the park to Girard Avenue.[78] Birkinbine in 1860 recommended acquiring land on the west bank of the Schuylkill River as well, in order to further protect the source of the city's water supply.[79]

City Councils' Committee on City Property announced in late 1858 a competition for the landscape design of the nascent Fairmount Park—at this time still only on the east side of the Schuylkill—and awarded the prize the following March to the landscaping and architecture partnership of Sidney & Adams, led by English-born James C. Sidney.[80] Sidney had produced numerous maps of Philadelphia and New York and had recently been commissioned to landscape the new southern portion of the prominent Laurel Hill Cemetery, a little further up the eastern shore of the Schuylkill River. Sidney was made park architect; he supervised its development and reported directly to the Commissioner of City Property.

Sidney saw much of his plan constructed, including a grand avenue lined with linden trees and curving along the shoreline from the east side of Fairmount's North Garden (visible in photographs), a carriage drive along the river,[81] winding walkways, and deciduous and evergreen trees along the perimeter of the park functioning as a screen against the surrounding urban environment. From 1859 until the Civil War began in 1861, about a third of his plan was

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[77] Water Department, *Chief Engineer's 1855 Annual Report* (17 Jan 1856), 5.
[78] The Sedgley property cost $125,000. A group of civic-minded citizens put up $60,000 toward the purchase and the Councils authorized a loan for the balance. Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 9.
[79] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 107.
[80] Michael J. Lewis, "The First Design for Fairmount Park," *The Pennsylvania Magazine of History and Biography*, Vol. 130, No. 3 (Philadelphia: University of Pennsylvania Press, Jul 2006), 283ff.
[81] The grand avenue and carriage drive along the river were the beginnings of today's Kelly Drive, above Fairmount and the Philadelphia Museum of Art.

completed at a cost of $22,500.[82] Even during the war years an additional $38,500[83] was spent on the park. By 1866, contrary to many modern accounts, Sidney's vision was largely realized.

Part of Sidney's responsibility was supervising the development of what came to be known as Boathouse Row.[84] Sidney's 1859 plan provided an area along the eastern shore of the river, at the base of Lemon Hill's bluff, in which boat and club houses could be built for rowing clubs. A rowing club had been founded as early as 1838 and by the mid-1850s a handful of such organizations had begun to build rudimentary, elongated sheds for their sculls. In 1858 the so-called Schuylkill Navy, a private body organized by the clubs, had been created to oversee activities, supervise and regulate the increasingly popular competitions, and provide for safety in an area that could be somewhat dangerous at times. In 1860 City Councils passed an ordinance allotting land for clubs and creating rules of appearance and decorum. Sidney exercised oversight and approval of clubhouse design and site selection for the Committee on City Property.

The Pennsylvania state legislature then did something dramatic. On 26 Mar 1867 it greatly enlarged Fairmount Park, on both sides of the Schuylkill River, and created the independent Fairmount Park Commission to manage it.[85] The two-fold purpose of the park and

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[82] The equivalent of approximately $757,300 in 2022.

[83] The equivalent of approximately $699,500 in 2022. The seeming discrepancy between the current approximate equivalents of the amounts spend between 1859 and 1861 and between 1861 and 1865 is due to the effects of inflation upon the value of the dollar during these years.

[84] Thomas G. Beischer, "Control and Competition: The Architecture of Boathouse Row," *The Pennsylvania Magazine of History and Biography,* Vol. 130, No. 3 (Philadelphia: The Historical Society of Pennsylvania, Jul 2006), 299ff.

[85] *Acts of Assembly Relating to Fairmount Park* (Philadelphia: King & Baird, 1868), 3ff. The City of Philadelphia had a year earlier purchased the large Lansdowne estate on the west side of the Schuylkill River. After 1773, John Penn assembled multiple tracts of land into a single property totaling approximately 200 acres, on which he built a mansion, probably near where Horticultural Hall stands today. When Penn died at age 67 in 1795, his widow sold the estate to James Greenleaf. When Greenleaf went bankrupt with Robert Morris in 1797, William Bingham purchased the property at sheriff's sale for $55,100. Although Bingham and his wife Ann were the leading couple of the "glitterati" of the immediate post-Revolutionary War years in Philadelphia, they both died young (Ann at age 37 in 1801, William at age 42 three years later). Alexander Baring purchased the estate in 1804 but the mansion remained unoccupied but for a tenant caretaker. On the Fourth or July in 1854 the great house was destroyed by a fire ignited by a group of children setting off fireworks. In 1866, facilitated by a group of four private citizens, the

its governing body was spelled out in the first section of the legislation: "…for the health and enjoyment of the people of said city, and the preservation of the purity of the water supply of the city of Philadelphia."[86] Together with supplemental legislation over the next few years, the act set the new boundaries of the park and granted the Commission the authority to purchase the land from the numerous owners of the existing properties. In fact, the legislation gave the Commission near total control over the park, including the ability to raise its own park police force. Among the designated commissioners were the mayor, presidents of the Select and Common Councils, Commissioner of City Property, and Chief Engineer of the Water Department.[87]

Graff was also a member of the commission's standing Committee on Plans and Improvements, created to manage the property.[88] This committee now regulated the placement and appearance of the boathouses—Sidney and the city's Committee on City Property were out and the Fairmount Park Commission's Committee on Plans and Improvements was in. A deadline of 1 Jun 1868 was imposed for tearing down all of the boathouses constructed prior to City Councils' creation of the rules in 1860. Thereafter the new committee would exercise architectural oversight of any new boathouses. Its control waxed and waned over the following decades, but its influence would be felt for generations. The result was that as the boathouses

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City of Philadelphia paid $84,953.30 for the land, a price per acre lower than any tract acquired by the City up to that time, under the stipulation it would become a public park. The estate became the keystone property of the portion of Fairmount Park on the west side of the Schuylkill River. See Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 12f; Thomas Westcott, *The Historic Mansions and Buildings of Philadelphia* (Philadelphia: Porter & Coates, 1877, 1894; Walter H. Barr, 1895), 333ff; Ryan K. Smith, *Robert Morris's Folly: The Architectural and Financial Failures of an American Founder* (New Haven: Yale University Press, 2014), 33ff.

[86] *Acts of Assembly Relating to Fairmount Park* (Philadelphia: King & Baird, 1868), 4.

[87] In addition, five commissioners were appointed by the District Court and five by the Philadelphia Court of Common Pleas. Among those appointed were George G. Meade (victorious commander of Union forces at Gettysburg), John C. Cresson (Chief Engineer of the Gas Works, President of the Franklin Institute), Strickland Kneass (the City's Chief Engineer and Surveyor), Eli K. Price (local lawyer), and William Sellers (mechanical engineer and manufacturer); prominent Philadelphians all.

[88] Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 3, 15.

grew in complexity over time, there was somewhat of aa unity of development, with each building making a unique contribution to the overall architectural personality of the whole.

That Graff was instrumental in managing the park during this time was not inappropriate. As Graff put it a few months later, the state's legislation creating the Fairmount Park Commission "makes protection of the purity of the Schuylkill water one of its first duties."[89]

In addition to purchasing wide expanses of land, such as the Lansdowne tract, on the west side of the Schuylkill River, the Fairmount Park Commission early on pursued the acquisition of a long-desired area closer to the Fairmount Water Works. This was the relatively low-lying, wedge-shaped area, known as the Flat Iron, which was situated between Fairmount on the south and Lemon Hill on the north, and from the Schuylkill River on the west to the Philadelphia and Reading Railroad on the east.[90] Recall that Thomas P. Cope had recommended its acquisition in 1844. Birkinbine had proposed the same in 1860.[91]

The Flat Iron wasn't very large, but crammed within its confines were furnaces, foundries, iron mills, stables, shops, residences, and a few hotels, arranged among a handful of blocks along Landing Avenue and bisected by a few side streets. The area was served by railroad sidings and horse-drawn street cars.[92] Among the hotels were the Rialto House and the Robert Morris Hotel, both four stories tall and fronting Landing Avenue, facing the river. The Rialto House was a particularly popular refreshment stop for visitors entering and leaving the park.[93]

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[89] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 20f.
[90] Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 25. Today Pennsylvania Avenue has been built atop the depressed rail line.
[91] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 107
[92] Pulled along rails, these were akin to horse-drawn trolley cars.
[93] Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 13; J. Thomas Scharf and Thompson Westcott, *History of Philadelphia, 1609–1884,* Vol. III (Philadelphia: L. H. Everts & Co., 1884), 1854.

Judging from depictions of the neighborhood at the time,[94] the troublesome nature of the area may have been exaggerated in the Fairmount Park Commission's annual reports—the Commission had a vested interest, after all, in justifying the forced removal of the area's businesses and residents—but a small sewer did empty into the Schuylkill River just upstream of the steamboat wharf above the Forebay[95] and contaminated runoff likely drained via open ditches into the short waterways that led to the river, befouling the water pumped up to the Fairmount Reservoir.

Ten years before the creation of the Fairmount Park Commission, the Pennsylvania state legislature had, on 13 May 1857, granted the city the authority to purchase the strip but City Councils didn't get around to passing its own enabling ordinance until 28 Jun 1864.[96] In December of that year a jury was assembled to assess just compensation for each of the 33 landowners. The jury didn't file its report for twelve months and when it did, the report was set aside due to legal irregularities. A second jury was convened but it encountered similar difficulties. It wasn't until 1868 that purchase prices were agreed upon[97] and the Flat Iron was finally added to the park, making an assembled area of approximately 110 contiguous acres on the east side of the Schuylkill River between Fairmount and the Schuylkill Works just north of Girard Avenue.[98]

The Fairmount Park Commission set up its offices in the vacated Rialto House in 1869,

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[94] For example, Benjamin Ridgeway Evans, *Landing Avenue and Coates Street* (as it appeared c.1860–65), watercolor on paper, 1867, Schwarz Gallery. Alternatively it has been suggested that the artist, in attempting to solicit sales of artwork from the owners of the hotels and other establishments, had a vested interest in portraying the area in a flattering light. See *American Works on Paper* (Piccari Press for the Schwarz Gallery, 2002), Plate 33.
[95] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 9.
[96] Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 25.
[97] The total cost came to $270,477. Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 11, 25f. The $55,000 mentioned on page 11 of the Annual Report may refer to the cost of the narrow strip of property immediately along the shoreline.
[98] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 376.

spending $2,262[99] to adapt the former hotel for its use.[100] In addition to the general business office, the former hotel accommodated engineers, draftsmen, and headquarters for the Park Guard and Harbor Police.[101] All of the other structures in the Flat Iron were demolished.[102] The next year the Commission employed a steam dredger to remove silt that had again built up along the shoreline in this area from Fairmount's Forebay to Boathouse Row[103]—what was turning out to be a recurring problem.[104] For now, the silt was the answer to another problem. It was deposited throughout the Flat Iron, raising the grade of the flood-prone land by an average of three feet.[105] With the Rialto House now sitting below the surrounding grade, however, the park offices in 1871 were moved and split between the nearby Lemon Hill mansion and the former buildings of the Belmont Petroleum Company on the western shore of the river just upstream the Philadelphia and Reading Railroad's Columbia Bridge.[106] The old hotel was demolished, and the site was regraded to match its surroundings.[107] In 1874 the grade was raised in places again, this time with 6,000 cubic yards of sediment removed from the Fairmount Reservoir during a

[99] The equivalent of approximately $49,300 in 2022.
[100] Including $474 for furniture. Fairmount Park Commission, *1869 Annual Report* (29 Jan 1870), 58, 62.
[101] Fairmount Park Commission, *1869 Annual Report* (29 Jan 1870), 35; Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 1; Fairmount Park Commission, *1878 Annual Report* (May 1878), 49. The Park Guard was a police force with jurisdiction solely within the Fairmount Park system. The Harbor Police, likewise, had jurisdiction on Philadelphia's waterways.
[102] Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 1; Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 13, 17; Fairmount Park Commission, *1878 Annual Report* (May 1878), 49.
[103] Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 3; *Fairmount Park Commission 1878 Annual Report* (May 1878), 48f; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 8.
[104] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 13ff; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 5ff; Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 12f; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 72f, 171.
[105] Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 2; Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 17, 30f.
[106] Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 30, 50, 53. The company was also known as the Belmont Oil Works.
[107] Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 30; Fairmount Park Commission, *1878 Annual Report* (May 1878), 51.

cleaning.[108]

In an early action, the Fairmount Park Commission picked up the slack where City Councils failed to follow through. In 1867 Mayor Morton McMichael called on Councils to create a board of hydraulic engineers which would provide a comprehensive examination of the "whole subject of water supply in all its aspects and bearing."[109] The Select Council approved the recommendation but the Common Council did not, thereby nixing the idea. In his role as president of the Fairmount Park Commission, however, the mayor led the independent body in accomplishing what Councils had rejected, at least within its own purview. It created a special committee, led by Graff, to examine the water supply within the Schuylkill River valley. Reporting on 11 Oct 1867, the panel's recommendations included the construction of an interceptor sewer running along the east side of the river from Manayunk to below the Fairmount Dam, the construction of reservoirs along certain streams at the headwaters of the Schuylkill River, the construction of a large storage and distribution reservoir within the city, the maximizing of water power at Fairmount, and the installation of auxiliary steam engines at Fairmount to draw water from below the Fairmount Dam during times when the water was too low to power the machinery or in the event of an accident with the dam.[110]

Not all of the properties that combined to form Fairmount Park needed to be purchased. On 11 Dec 1868, for example, 83-year-old Jesse George and his 79-year-old sister Rebecca George donated to the City 83 acres of their family's estate, the portion known as George's Hill, in exchange for a $5,000 annual stipend for the rest of their lives.[111] With the value of the grant

[108] Fairmount Park Commission, *1878 Annual Report* (May 1878), 58; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13. "The mud," as noted in the Water Department's annual report, "was about eighteen inches deep" in the reservoir's basins.
[109] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 20.
[110] Fairmount Park Commission, *Report…Upon the Preservation of the Purity of the Water Supply* (Philadelphia: King & Baird, 11 Oct 1867), ; Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 20f.
[111] The equivalent of approximately $104,300 in 2022.

estimated at $100,000,[112] the stipend only amounted to approximately what the Fairmount Park Commission would have paid in interest had it been required to take out a loan to purchase the land.[113] Within two years the George's Hill Reservoir, to which the Belmont station would pump, would be under construction nearby.[114]

Ultimately the Fairmount Park would expand to an area covering 2,052 acres on either side of the Schuylkill River upstream of Fairmount, with an additional 2,042 acres in the adjoining Wissahickon Valley Park.[115]

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In the summer of 1868 Graff initiated a chain of actions and events that would mark the beginning of a controversy so great it would contribute to his leaving public service for good.

Earlier in the year a steam engine had broken down at the Schuylkill Works just as another engine was in the process of being replaced. In order to prevent a water shortage in the area supplied by the station, Graff quickly ordered from the Worthington Hydraulic Pump Works a steam engine of a new duplex design.[116] Although relatively small, the duplex promised to be more powerful for its size than other engines and it did not disappoint. It worked so well in its

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112 The equivalent of approximately $2.1 million in 2022.

113 Rebecca George died on 10 Nov 1869 at the age of 79, less than five months after a well-attended public dedication ceremony atop George's Hill in June 1869. Jesse George died on 14 Feb 1873 at the age of 86. Fairmount Park Commission, *1868 Annual Report* (31 Dec 1868), 21ff.; Fairmount Park Commission, *1869 Annual Report* (19 Jan 1870), 14, 53; Phebe Westcott Humphreys, "Famous Banqueting Houses," *Table Talk,* Vol. XXIV, No. 4 (Philadelphia: Table Talk Publishing Co., Apr 1909), 148ff.

114 Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 11. The reservoir was located to the north of Jesse and Rebecca George's donated land. Today the Mann Music Center is situated nearby.

115 City of Philadelphia, *Emerald Ash Borer Management Plan* (2012), 1.

116 The engine's capacity was rated at two million gallons per day. See Bureau of Water, *Chief Engineer's 1898 Annual Report* (20 Jan 1899), 52; Walter A. Graf et al., *The Water Works of the City of Philadelphia: The Story of their Development and Engineering Specifications* (19 Nov 1957), *Philly H_2O,* <http://www.phillyh2o.org/backpages/GrafHistory_HSP.htm#Chapter10>, accessed 14 Aug 2020.

auxiliary role at the Schuylkill Works that when the malfunctioning engine was repaired and the installation of the new permanent engine was complete, Graff had it moved to the 24th Ward Works on the west side of the Schuylkill River in order to supplement the operation there.[117]

After Fairmount struggled through a number of very dry summers, including the especially severe drought in the summer and fall of 1869 mentioned earlier, Graff moved the engine there in 1872 to supplement the water power during the hottest months.[118] He combined it with a surplus boiler brought over from the Delaware Works and installed it in an ornamental building (visible in some historical photographs) on the wharf between the outer Forebay and the steamboat landing. A 12-inch discharge main was run up an interior corner of the Distribution Arch[119] and connected to the northwest corner of Basin No. 2 of the Fairmount Reservoir.[120] The engine was in use at Fairmount from 1872 to 1876.[121] Although its contribution as a percentage of Fairmount's total pumpage usually remained in the single digits, it was at times more significant. In the summer of 1872, for example, it contributed sixteen percent of Fairmount's output for the month of July.[122]

The 24th Ward Works[123] had been supplying the area of Philadelphia west of the

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[117] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 9f, 11, 12; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 9f.

[118] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 7. In his notes c.1872, Frederick Graff, Jr., referred to it as the "Worthington Engine at Fairmount" and describes it as having a 25-inch steam cylinder draw, a 16-inch pump cylinder draw, a 24-inch stroke length, and a 3-inch pump rod draw. See Frederick Graff, Jr., *Notebooks* (c.1872), Historical Archives, Philadelphia Water Department, Accession Nos. 2004.062.0001 and 2004.062.0003. The engine had a little less than half the capacity of each of the turbines in the Old and New Mill Houses and each of the first two Worthington engines at the Belmont Plant. See Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), table at 109, table at 111.

[119] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), diagram at 129. The Annual Report for 1874 mentions "stone standpipe tower," but diagram in Annual Report for 1874 clearly shows connection with Distribution Arch. The Distribution Arch, further, was of stone construction while the Standpipe was brick masonry.

[120] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 7.

[121] Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), daggered footnote to table at 71.

[122] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 33f.

[123] The pumping station was located where Interstate 76 (the Schuylkill Expressway) today passes between the eastern side of the Philadelphia Zoo and the west bank of the Schuylkill River.

Schuylkill since shortly after the Consolidation of 1854. Begun while West Philadelphia was still a separate municipality, the station was never more than barely adequate and was perennially troublesome.[124] Although Birkinbine had begun construction of a new reservoir for the station in 1866,[125] Graff decided to replace the pumping station itself with a new one a little over a mile upriver.[126] Already impressed with the performance of the small Worthington engine, in the summer of 1868 Graff proposed to contract with the company to manufacture two much larger duplex pumping engines for Belmont, each capable of raising five million gallons per day to the new reservoir[127] and each costing $47,500.[128]

The Worthington duplex condensing pumping engine had been developed a few years earlier by the brilliant mechanical and hydraulic engineer Henry R. Worthington (1817–1880). The innovative design was, in effect, two steam engines set side by side with each engine's piston rod operating the steam valves of the other. The duplex engine ran more smoothly than other engines and there was no need for a cumbersome flywheel because each side covered the other's low-momentum periods in the operating cycle.[129] Worthington's company gained a reputation for the production of superior pumping engines. Its duplex designs were employed well into the twentieth century to pump water and oil through mains and pipelines.

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[124] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 12; *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 71f. See also "The Water Department," *The Sunday Atlas* (7 Nov 1858).
[125] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 27, 60.
[126] Construction of the new station, called the Belmont Works, got under way in November of 1868. See Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 13.
[127] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 13.
[128] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 74; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 70. The amount was the equivalent of approximately $990,700 in 2022.
[129] "Worthington Duplex Pumping Engine, 1891" (description), *New York Public Library/Science Source*, <https://www.sciencesource.com/archive/Worthington-Duplex-Pumping-Engine--1891-SS2529219.html#/SearchResult&ITEMID=SS2529219&POPUPPN=1&POPUPIID=2OPEBMEB5WO7>, accessed 23 Mar 2020.

There was only one problem. Worthington's shop was located in Brooklyn,[130] New York.[131]

Almost immediately the proposed purchase blew up in the local press.[132] Philadelphia companies were selected in the past; were there no longer any local firms capable of building a suitable engine? Why did Graff make the selection himself without opening the process to competition? Why did Graff give the contract to a company from New York, of all places?

The small Worthington engine Graff had ordered for the Schuylkill Works had only cost a little less than $7,700[133] and hadn't attracted any attention. The double order for nearly $100,000[134] was something else entirely.

Graff did have his defenders. The editor of the *Public Ledger,* for example, wrote:

> It is, of course, sound policy always to prefer home manufactures over all others, if the conditions of the case are anything like equal, or unless there is sound and strong reason for going elsewhere to procure the best article of the kind wanted. Most thinking men act on this principle where business matters are concerned. But to reject a really superior and valuable article simply because it is made elsewhere is not wise, and scarcely any business man ever acts on such an idea.[135]

The editor proceeded to describe all manner of goods, from locomotives and gas fixtures

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[130] Maggie Blanck, "Worthington Hydraulic Pump Works, *Industry and Commerce in Red Hook,* <http://maggieblanck.com/BrooklynRedHook/Worthington.html>, last modified Jun 2016, accessed 27 Mar 2020.
[131] Until 1898, when it was incorporated into the City of New York, Brooklyn was a separate city. At the time of its consolidation with New York, it was the fourth largest city in the United States, after New York (Manhattan), Chicago, and Philadelphia.
[132] See for example Economy, "The Contract for Pumping Machinery [letter to editor]," *Philadelphia Inquirer* (8 Jun 1868), 2; Engineer, "A Reply to 'Economy' [letter to editor]," *Philadelphia Inquirer* (10 Jun 1868), 2; "The New Pumping Engines for the Twenty-fourth Ward [editorial]," *Philadelphia Inquirer* (22 Jun 1868), 3; "Who Can Answer? [editorial]" *Evening Star* (unknown date).
[133] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 67. The amount was the equivalent of approximately $160,600 in 2022.
[134] The equivalent of nearly $2 million in 2022.
[135] "Common Sense of the Worthington Pump Controversy [editorial]" *Public Ledger and Daily Transcript* (18 Jun 1868).

to chemicals and cosmetics, which were shipped from Philadelphia to all parts of the country and the world. “If all [of those customers] should act on the narrow and short-sighted policy brought to bear in the ‘pump’ case,” he asked, “what would become of some of our great staple manufacturers?[136] If everyone only bought local, in other words, the wider markets for the products of our own companies would dry up.

Graff continued, however, to attract criticism from the public, the local industrial community,[137] and the political class. The issue was controversial with the public because selecting Worthington without competitive bidding looked as if it were part of the growing corruption in Philadelphia politics. It was unpopular with the local manufacturing community because some of the industrial leaders felt cheated out of potential business. It became a sore spot with City Councils and machine politicians, however, for a different reason. If contracts were given to companies outside of Philadelphia, the machine would have practically zero chance of directing public money to favored individuals and seeing some of that money re-directed back to fund its own political operation. From the machine’s perspective, this was not the sort of thing to be encouraged.

Graff, however, was not the sort of man to let political considerations interfere with the technical aspects of managing the city’s water supply system. He knew superior engineering when he saw it. He had first-hand experience with the performance and economy of Worthington’s design. There was also the lesson to consider of the drought of 1869 and the legal rebuke the City of Philadelphia had received. Graff undoubtedly realized that the City had to work toward the day when pumping on the Schuylkill was almost entirely powered by steam and

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[136] “Common Sense of the Worthington Pump Controversy [editorial]” *Public Ledger and Daily Transcript* (18 Jun 1868).
[137] “Proceedings of City Councils,” *Philadelphia Inquirer* (26 Jun 1868), 3.

this almost certainly served to stiffen his spine as well.

Far from backing down in the face of criticism, within two years he doubled down and ordered from Worthington two additional engines of the same type— a somewhat smaller one for the Delaware Works[138] and one for the Roxborough Works which was 20 percent larger than either of the Belmont engines.[139] The engine for Delaware cost $35,000[140] and the one for Roxborough cost $55,000.[141]

In September 1870, days after Graff's placing the order for the Roxborough engine, the president of the Norris Iron Works made a formal complaint to the Common Council, demanding to know why a $100,000 order had been made without competitive bidding. He then leaked the communication to at least one local newspaper.[142] The Council responded by appointing an investigating committee.[143] On 4 Apr 1871, the five-Councilman panel grilled Graff in the office of the Clerks of Councils. Not cowed in the slightest, Graff explained that his considerable experience and expertise allowed him to judge that Worthington's engines were the best that could be obtained for the specific applications and that no other company was asked to bid because the engine design was patented and only Worthington had the right to build it. He noted

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[138] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 9, 75.
[139] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 12.
[140] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 75; Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 73; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 92. The amount was the equivalent of approximately $791,300 in 2022.
[141] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 77; Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 96. The amount was the equivalent of approximately $1.2 million in 2022.
[142] The executive, T. T. Woodruff, must have thought that a little public exaggeration couldn't hurt. He would certainly have known that the cost of the engine itself was far less than the amount he quoted and that all of the peripheral equipment, materials, services, and labor necessary to install the engine at the Roxborough station—such as the boiler, connecting main, piping, enlargement of the engine house, reinforced masonry foundations and the like—were routinely contracted with local firms. See Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 65; Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 67; Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 58; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 68.
[143] "City Councils: The Proceedings Yesterday," *Daily Evening Telegraph* (24 Mar 1871), 3; "City Intelligence," *Philadelphia Inquirer* (24 Mar 1871), 2.

that the combined Committee on Water had approved the purchase. Turning the table on his accuser, Graff pointed out that the Norris Iron Works manufactured steam engines and pumps for the water works of the city of Erie, Pennsylvania, and wondered why the president of the company should protest when a company in another city does the same thing in Philadelphia.[144] In other words, wasn't what was good for the goose good for the gander? Nine days later, the committee reported that it had determined the contract to be legal.[145]

At Belmont, meanwhile, the building was completed and the first of the Worthington duplex engines was installed. It became operational on 19 Sep 1870, after a 25-hour trial during which its work output was measured at 20 percent higher than the contract specification. The same day, the 24th Ward Works was shut down for good.[146]

On 18 Jul 1871 the second Worthington duplex engine became operational at Belmont. A month later, in addition to its primary area west of the Schuylkill River, the Belmont Works began to supply certain areas on the east side via a submerged main across the river. With the building at Belmont designed with room for three engines, Graff anticipated the acquisition of a third Worthington duplex. "The two already erected have proven so eminently satisfactory," he affirmed, "that I can see no reason for adopting any other form."[147]

At the Delaware Works, the Worthington engine was installed and became operational on 25 Oct 1871.[148] The controversy, however, began to have a political effect. In February of 1872, Graff groused that while the duplex engine he had ordered for Roxborough in 1870 was finished and waiting at Worthington's shop, "unavoidable delays" had prevented the completion of the

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[144] "The Worthington Engine," *Philadelphia Inquirer* (5 Apr 1871), 2.
[145] "City Councils: Their Proceedings Yesterday," *Daily Evening Telegraph* (14 Apr 1871), 3.
[146] Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 10f.
[147] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 9f.
[148] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 8.

purchase and delivery.[149]

After calls in the press to test the Worthington design to determine if it were as good as Graff was claiming, Councils commissioned another five-member team,[150] this one consisting of local engineers who were experts in steam technology.[151] It didn't help to dispel concerns of corruption when in the lead-up to the tests, during a meeting of Councils' combined water committee, Select Councilman John A. Shermer joked about bribing the test team and Common Councilman Jacob M. Davis responded, to laughter all around, that perhaps $25,000[152] should be appropriated for it.[153]

Nevertheless, the investigation team conducted a thorough evaluation.[154] It selected the second Belmont engine as representative of the lot and put it through a test regimen over a period of three days.[155] The resulting data showed that the engine's work output[156] was 26.24 percent higher than the contract specification and its actual pumpage[157] was 11.47 percent higher than the requirement.[158] "The engines," the team concluded at the end of May 1872, "are fairly and easily performing considerably beyond the guarantee."[159]

Graff's march of the Worthington engines continued. In late 1872, the duplex engine ordered for Roxborough was installed and became operational. With what he saw as complete vindication, and in defiance of vocal opposition, by January 1873 Graff contracted with

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[149] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 10.
[150] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 12.
[151] Including maritime boiler and steam engine manufacturer Jacob G. Neafie, Eagle Iron Works president Henry L. Hoff, steam engine expert W. Barnet LeVan, and former Water Department Chief Engineer Cassin. The team did not, appropriately, include Graff himself. See Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 32.
[152] The equivalent of over $600,000 in 2022.
[153] "The Water Committee," *Philadelphia Inquirer* (6 Mar 1872), 2
[154] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 27ff.
[155] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 27f.
[156] Expressed as the number of pounds raised one foot high using 100 pounds of coal.
[157] Expressed as cubic feet or gallons raised to the reservoir, compared to the theoretic or calculated capacity.
[158] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 27f, 31.
[159] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 32.

Worthington for Belmont's third engine. This time he ordered an even larger one, with 60 percent more capacity than the first two,[160] although at $48,000[161] the cost was only slightly more than each of the first two.[162]

It was all too much for the politicians[163] but even while the issue was playing out, another controversy slowly began to build. Together the two would spell the end of Graff's public career.

By the mid-1860s, the need for additional reservoirs had become apparent. Supply managed to keep up with demand, if only barely, but the storage capacity had not kept up with the supply. In 1864, during Birkinbine's second tenure as Chief Engineer, the city's total storage capacity was only 85 million gallons, less than three days' reserve during average demand and only two days' during peak demand.[164] Birkinbine had recommended that a storage reservoir with a capacity of at least 500 million gallons be constructed in a suitable location 230 feet above City Datum.[165] Three years later he warned that demand had increased to the point that the reservoirs held only two days' supply during normal demand and again urged the construction of additional storage space. He repeated his estimate that the city needed a total reservoir capacity of "at least 500 million gallons."[166]

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160 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 12.

161 Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 89; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 69. The amount was the equivalent of approximately $1.2 million in 2022.

162 The third Worthington engine at Belmont would become operational later in 1873. See Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 14.

163 Within ten years, however, the issue had ceased to be controversial. In 1882 a Worthington engine was installed in the Schuylkill Works and an additional two were installed there two years later. See Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 86; Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 166, 171.

164 Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 15.

165 Henry P. M. Birkinbine, *Report to the Select and Common Councils* (31 Mar 1864), 6f. Birkinbine suggested a few locations he thought warranted further investigation. The elevation of the City Datum (formally Philadelphia City's Surveyor's Datum) is a little more than 6½ feet below the crest of Fairmount Dam. See Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), diagram at 153. It is defined as 8.73 feet above mean ocean level. See *Proceedings of the American Philosophical Society*, Vol. 16, No. 97 (Jan–Jun 1876), 64, 100, 102; Claire Donato, Mark B. Thompson Associates, to Public Affairs, Philadelphia Water Department, 16 Apr 2003.

166 Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 35.

In August of 1867, two months before the reconfiguration of the Old Mill House was begun, a freshet occurred during which the Schuylkill River crested seven feet, four inches above Fairmount Dam.[167] At the same time, part of the embankment and brick lining of the Corinthian Avenue Reservoir collapsed, preventing its use.[168] Worse still, a slope failure along the Reading Railroad line above the Schuylkill Works caused over 3,000 cubic yards of earthen fill and track ballast[169] to slide into its forebay. The obstruction—110 feet long, 54 feet wide, and 16 feet deep—completely shut down operations at the works.

Although the breast wheels in the Old Mill House were sidelined throughout the high water event, the turbines and pumps in the New Mill House were able to keep running though partially submerged, "showing one of the advantages of this kind of motor."[170] And because of the recent installation of an additional connecting main, the New Mill House was able to supply water to the Schuylkill Works' Spring Garden Reservoir.[171]

With the ability of the New Mill House to supply both the Fairmount Reservoir and the reservoir for the sidelined Schuylkill Works, Fairmount supplied water to the entire upper portion of the city, which would have gone without. Even so, it was still a struggle for Fairmount. Graff reported that the majority of Philadelphia's residents and businesses were six hours away from running out of water. The water that was provided, moreover, was muddy because there wasn't sufficient storage capacity to allow the pumps to shut down while the water in the Schuylkill River was turbid.

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167 Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 11f.
168 Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 12. This was not the first time an accident of this sort had occurred there. See Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 17f.
169 Railroad track ballast is coarsely crushed rock placed beneath and between the ties. It stabilizes the track and allows thorough drainage. See Dingqing Li, et al., *Railway Geotechnics* (CRC Press for Routledge Handbooks, Sep 2015), 71ff.
170 Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 11.
171 Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 10f.

The pressing need for additional pumping capability and storage capacity had again been demonstrated, but in February 1869 Graff reported that he had identified a "suitable location for a new reservoir" within the bounds of Fairmount Park.[172]

If the 1867 freshet wasn't enough, however, the danger from the lack of storage capacity was brought into piercing focus by the 1869 drought mentioned earlier, the worst since the water-powered works at Fairmount were first built in 1822. As we have seen, the system was barely able to keep up with demand during this dry period and the City was forced to draw water from the Fairmount Pool to the point that navigation on the Schuylkill Navigation system was impossible, resulting in far-reaching legal repercussions.

When rain returned, however, it came with a vengeance. The worst drought since 1822 was followed by the worst flood on record, before or since. On Friday 4 Oct 1869 the Schuylkill River crested at 17 feet above the top of Fairmount Dam,[173] completely submerging the machinery at Fairmount and damaging a few of the breast wheels, one of the turbines, and some of the support equipment.[174]

Graff needed to add steam power and do so quickly. The lead time for manufacturing a steam engine was long, however, and the competition with other cities for ready-made, off-the-shelf steam engines was intense, so Graff had to search for existing steam engines wherever they may be found. Graff finally persuaded a maritime salvage company to sell to the Water

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172 Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 14.

173 This was higher than the crest of 14.65 feet on 23 Jun 1972 during Hurricane Agnes and the crest of 16.35 feet on 2 Sep 2021 during Hurricane Ida. See *Hurricane Agnes Rainfall and Floods, June–July 1972/Geological Survey Professional Paper 924* (Washington, D.C.: U.S. Geological Survey and National Oceanic and Atmospheric Administration, 1975), 99; "Schuylkill River at Philadelphia, PA," *U.S. Geological Survey*, <https://waterdata.usgs.gov/monitoring-location/01474500/#parameterCode=00065&period=P365D&compare=true>, accessed 16 Dec 2021.

174 Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 7; "In Philadelphia—Immense Damage—Bridges Carried Away—Two Lives Lost," *The New York Times*, 10 Oct 1869, <http://www.gendisasters.com/pennsylvania/1451/philadelphia,-pa-area-storm-flood,-oct-1869>, accessed 23 Aug 2016. This storm is sometimes referred to today as the Saxby Gale Hurricane.

Department two steam engines and Knowles pumps[175] from one of their wrecking steamships. He installed them near the Forebay at the foot of Fairmount where they provided the supplementary pumping capacity.[176]

It was only through the cooperation of the Schuylkill Navigation Company and the willingness of citizens to cut back on consumption—avoiding the usual practice of rinsing their stoops and sidewalks, for example—that a large-scale shortage of water was averted. Only minor shortages were experienced in some of the higher elevations.[177] Disaster was prevented but just barely. If nothing was done it was only a matter of time before the same thing, or worse, happened again.

In an urgent appeal to Councils on 30 Nov 1869, Graff explained that any city would always have a sufficient supply of water if it had a reliable pumping capacity in excess of demand, adequate storage capacity, or both. Because Philadelphia had neither, he argued, it was in a vulnerable position.[178] With little resilience in the system, if a problem occurred—such as the breakdown of a steam-powered station or a major change in the weather—there was a significant risk of catastrophe. Graff noted that when he had resumed the position of Chief Engineer, the first thing he had done was begin the substitution of breast wheels for turbines in Fairmount's Old Mill House and shore up the capacity at selected steam-powered pumping stations.[179]

Graff called for an immediate effort to increase steam power and construct additional

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[175] The two Knowles pumps were moved in 1870 to an auxiliary pumping station at the Roxborough Reservoir where they were used to send water to the Germantown area. See Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 12.
[176] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 6.
[177] Water Department, *Chief Engineer's 1869 Annual Report* (10 Feb 1870), 7.
[178] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 3.
[179] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 5.

reservoir space on both sides of the Schuylkill River. On the east side he identified two locations which would allow construction of reservoirs, a site near the Strawberry Mansion (a historic property) and a site in the so-called East Park section of Fairmount Park. Whatever other characteristics they possessed, both locations had the advantage of being on ground already owned by the City of Philadelphia.[180]

At the Strawberry Mansion site, Graff estimated a reservoir holding 89,130,000 gallons could be built at 150 feet above City Datum for $425,000.[181] A 13,350-foot-long 36-inch main costing $140,000[182] would need to be laid from the Schuylkill Works. A 36-inch, 10,000-foot-long 36-inch main connecting the reservoir to the distribution system would cost $125,000[183] and round out the price tag to $690,400.[184]

Although a reservoir in the East Park would be at a somewhat lower elevation, at 130 feet above City Datum, its location would allow it to be much larger, holding 635,704,200 gallons. Graff estimated it would cost $1,164,407.[185] Because this location was closer to the Schuylkill Works, the 36-inch main from the river would only need to be 3,200 feet long and cost $57,600.[186] The 36-inch connecting main would be shorter as well, at 5,300 feet, and cost $95,400.[187] Graff estimated the total cost at $1,317,407.[188]

Between the two, Graff recommended moving ahead with only the East Park Reservoir.

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[180] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 7ff, 14ff.
[181] The equivalent of approximately $9.3 million in 2022.
[182] The equivalent of approximately $3 million in 2022.
[183] The equivalent of approximately $2.7 million in 2022.
[184] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 15, 19f. The amount was the equivalent of approximately $15 million in 2022.
[185] The equivalent of approximately $25.4 million in 2022.
[186] The equivalent of approximately $1.2 million in 2022.
[187] The equivalent of approximately $2.1 million in 2022.
[188] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 16, 19. The amount was the equivalent of approximately $28.7 million in 2022.

It would have over seven times the capacity of a reservoir at Strawberry Mansion for a little less than twice the price. It was situated ten feet higher than the Corinthian Avenue Reservoir and could supply all but the highest areas of the city. Those areas, he said, could be supplied by auxiliary pumping and additional small reservoirs for a relatively small cost.[189]

There were problems almost immediately. On 15 Mar 1870 City Councils appropriated only about a third of the funds Graff requested for the reservoir and numerous other projects in his November 1869 communication. Graff had intended to begin construction by the summer of 1870 but he was forced to divide the available funds among the most urgent projects so that some of them would at least started. The cost of the East Park Reservoir was so large, however, that it was one of the projects which was delayed entirely.[190]

Councils intended to provide the remainder of the necessary funds via a loan, but passage of the loan bill was delayed by a protracted debate. During the delay, an injunction by the Pennsylvania Supreme Court prevented the Water Department from expending any funds against the loan's eventual approval. When the loan bill was finally passed, Mayor Daniel M. Fox vetoed the legislation.

The delay was bad enough, but the reasons the mayor gave for vetoing the loan bill were worse. Fox said Councils failed to include in the bill any plans, cost estimates, or target completion date. There were no details provided as to how the money would be spent, no specifications as to the dimensions, materials, methods of construction, nor even the specific location of the East Park Reservoir itself. He rejected the discretionary power, "so vast and so vague," the bill gave to Graff. Instead of Water Department employees, said the mayor, the work

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[189] *Communication from Frederic Graff [To the Presidents and Members of Select and Common Councils]* (30 Nov 1869), 16.
[190] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 5f.

should be done by a contractor "under the restrictions of a well-drawn contract."[191] Graff took the veto as a personal and very public rebuke to his trustworthiness.

A writer to a local newspaper pointed out that virtually all large construction projects were performed under contract. Among the many examples the letter-writer cited was one which was particularly apt—the construction of the Academy of Music in 1857.[192] Graff was a founding member of the Academy's board of directors and served on the building committee as the trustee of the building fund throughout the design and construction of the Academy's grand new home and performance hall from 1854 to 1857. In fact, he had helped select the contractor who was awarded the responsibility for the project's construction.[193]

On the surface it may seem that the mayor was advocating for a clean process and proper accountability, but the reality was a little different. It was an era of unapologetically corrupt machine politics. At the time, Fox was a rare Democrat amid a string of Republican mayors in Philadelphia.[194] Although Graff was not a party politician, he was nominally a Republican.[195] The amount of money in play was considerable and political power could be gained from the jobs the work would generate. Jobs were routinely traded for votes; each job meant not only the worker's vote, but likely those of his family and friends.

Corruption took another form as well. It was common for a favored contractor to be paid more than work would ordinarily cost. The contractor would then "kick back" the extra money to the political machine in the form of a campaign contribution, often under the table. It was a form

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[191] *Journal of the Common Council, Appendix 167* (22 Aug 1871), 61ff.
[192] Tax Payer, "Graff and the $2,122,000 Appropriation," clipping from *Philadelphia Inquirer* (prob. 1871).
[193] *History and Description of the Opera House or Academy of Music, in Philadelphia* (Philadelphia: G. André & Co., 1857), 4f. The contractor, John D. Jones, completed construction in nineteen months. See also See "Memoir of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 521.
[194] Serving from 1 Jan 1869 to 1 Jan 1872, Fox was the second of only two post-Civil War-era Democrats to be elected mayor of Philadelphia. The other was Samuel G. King who served from 4 Apr 1881 to 7Apr 1884.
[195] Graff had previously been a Whig, but that party had foundered by the 1850s. Many Whigs, Graff among them, found a home in the newly formed Republican

of money laundering, of public money in this case. Some of the money might enrich the machine politicians, but some of the it might also be used at the neighborhood level in various charitable activities to make the party machine look good come election time. Some of the money was at times even spent directly buying votes. In this way a political machine could become firmly entrenched.[196]

It's likely the mayor wished to direct the fruits of this system toward his own party. The Democrat party was weak and facing an uphill battle against the more highly organized Republican machine. Even if Graff had no intention of playing machine politics with Water Department work, the mayor would probably have considered it a wasted opportunity.

Graff replied to the mayor in a letter to Councils, but oddly did not directly address the mayor's objections. He instead reiterated the importance of the East Park Reservoir and other improvements which would be funded and defended their cost. It was a tepid response.[197]

Eventually a loan bill was passed and signed by the mayor. Funds for the East Park Reservoir were finally made available on 6 Nov 1871, nearly two years after they were requested. Graff complained that the better part of two construction seasons had been lost.[198]

Three days after the funds were made available, construction on the East Park Reservoir got under way and continued into 1872. The initial work consisted of site preparation. The area under work was large; the circumference of the embankments was 1½ miles. Park roads needed to be re-routed and the land leveled. Topsoil, 15 to 18 inches deep, was removed and stockpiled

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[196] Because of the various forms of political corruption, the City of Philadelphia got far less bang for its buck than it should have. The cost to the city of work, materials, goods, and services was artificially high, and the quality it got in return was often shoddy. In a minor example, when the Bureau of Water was moving its offices into the new city hall in 1896, John C. Trautwine, the Bureau's chief engineer at the time, wondered why the new furniture would cost over eight times more than it should. See Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 127. More seriously, a perennial complaint by successive chief engineers was poor workmanship of reservoir embankments, often requiring repeated, extensive, and expensive repairs and resulting in operational disruption.

[197] *Journal of the Common Council, Appendix 168* (22 Aug 1871), 64ff.

[198] Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 5f.

for later use on the exterior perimeter of the completed embankments. Graff assigned Assistant Engineer James M. Kreamer to shepherd the project, as Kreamer had done with the Belmont and Delaware Reservoirs. Contractor Edward S. McGlue was hired as general superintendent, what today we might call the onsite supervisor. McGlue had provided the same service during construction of the Delaware Reservoir.[199]

As mayor, Fox may have wanted Graff to use contract labor, but he was no longer mayor. William S. Stokley, a Republican, had been elected mayor in October 1871, taking office on the first of the new year. Graff proceeded to use Department employees as he had intended. At times the work slowed due to difficulty obtaining sufficient workers.[200]

There may have been a new mayor but the controversy had not abated. The construction contracts would merely be pointed in a different direction. Stokley had risen from a private fire company officer to become mayor, a position he would hold until 1881. He had allies in Select and Common Councils from his days as president, in turn, of both bodies. As mayor, he ran the office like a graft ring. For example, he was instrumental in steering the site selection for the new City Hall toward Penn Square and he packed the Public Buildings Commission with his cronies. While mayor in 1872, he ensured the massive building's foundations would be constructed of marble instead of the expected granite, and then directed a $5.3 million no-bid contract[201]—the largest municipal contract in the history of the city up to that time—to associates of his. Stokley ended up with a $20,000 mansion[202] on Filbert Street, courtesy of the building contractors, as a

[199] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 17.
[200] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 16f.
[201] The equivalent of approximately $128.7 million in 2022.
[202] The equivalent of nearly $500,000 in 2022.

reward.[203]

Graff had projected that the reservoir's embankments would be completed by the end of 1873, but when the work paused for the winter they were still incomplete. A portion in the northeast corner had been raised to within ten feet of the design height, but other parts were only twelve, nine, or four feet high.[204]

By then, however, Graff had been forced out. The Worthington engine controversy—played out in the press—already made him a vulnerable target. His resistance to padded construction contracts connected with the East Park Reservoir now cost him support from the mayor and his allies in Select Council. On 13 Feb 1873, in what should have been a routine re-election, Graff lost to William H. McFadden in City Councils by 64 votes to 8.[205] McFadden took office on 1 Mar 1873.[206] Now age 55, the whole experience so soured Graff on public service that he would never to return to it, even when urged to do so by friends and colleagues years later.[207]

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[203] Bureau of City Property, *Directory of Philadelphia City Hall* (Philadelphia: Dunlap Printing Co., 1908), 26f, 38ff, 43f; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 439; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 22ff.

[204] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 13.

[205] *Journal of the Common Council of the City of Philadelphia for the Year 1873,* Vol. I (1873), 131ff. McFadden received 18 Select Council votes and 46 Common Council votes; Graff received two Select Council votes and six Common Council votes. Former Chief Engineer Isaac S. Cassin received a total of 12 votes (five from Select Council members and seven from Common Council members).

[206] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 5; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 45.

[207] "Memorial of Frederic Graff [Jr.]," *Journal of the Franklin Institute* (Jun 1890), 519. After his retreat from public life in 1873, Graff remained productive. He worked directly for the Worthington company from 1873 to 1877, designed the water supply system for the Centennial Exhibition, and consulted on the design of water systems for other cities. A member of the Franklin Institute since 1839, he served as Vice President from 1882 until his death. He continued as a director of the Academy of Music from 1854 until 1884. He was long a member of the Academy of Natural Sciences and a trustee of its Building Fund. The year he left the Department he was elected a member of the American Society of Civil Engineers and served as president for two years beginning in 1885. In 1879 he was elected a trustee of the Pennsylvania Museum and School of Industrial Art, serving as Vice President from 1882 until his death. He was elected president of the Engineer's Club in 1880. He was one of the founders of the Zoölogical Society of Philadelphia (whose zoo, now known as the Philadelphia Zoo, was in 1874 the first of its kind in America) and was elected president in 1882. A serious photographer, he founded the Photographic Society of

Graff had initially designed the East Park Reservoir with two basins, one much larger than the other, separated by a low, semi-circular internal embankment which would be submerged when the reservoir was full. This was for operational flexibility, to facilitate maintenance and repairs, and for safety's sake in case of accident like some sort of embankment failure.[208] By 1873 the design was altered to three unequally sized basins, two larger and one smaller, with internal embankments which would rise high enough to fully divide their contents.[209] The internal embankment dividing the two larger basins was begun in the fall. The embankment in the northeast corner was raised to within ten feet of the planned finished height, but work on other portions was not nearly as advanced. Connections and valve houses were partially completed. Much waste material, such as top soil and excavated rock, remained and had to be hauled away to a spoil site.[210]

McFadden initially used Department employees as Graff had, but late in 1874 switched to contract labor superintended by contractor Edward S. McGlue.[211] The design capacity of the reservoir was enlarged to 701,319,554 gallons.[212] Construction continued into 1875 but so did the controversy. In July work came to a halt. In the spring of 1873 McFadden had been optimistic about finishing the smallest of the basins by year's end,[213] but now more than two

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Philadelphia in 1862 and served as president from 1867 to 1870 and from 1886 until his death. In 1887 he became a director of the Pennsylvania Institute for the Deaf and Dumb. He even managed to squeeze in a tour of Europe with his wife Elizabeth (neé Mathieu) in 1878. He suffered from heart disease later in life and died at the age of 73 in 1890 of sudden heart failure, leaving no children. See also "The Photographic Society of Philadelphia," *The American Amateur Photographer,* Vol. 1 (Philadelphia: Jul 1888–Jan 1889), 179ff; "In Memoriam: Frederic Graff," *The Photographic Times,* Vol. XX, No. 447 (Photographic Times Publishing Association, 11 Apr 1890), 174; *Proceedings of the American Society of Civil Engineers,* Vol. XVII (New York: Aug 1891), 247ff; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 376.

[208] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 16, and map at frontispiece.

[209] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 13; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), diagram at 157.

[210] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 13f.

[211] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 26.

[212] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 157.

[213] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 13.

years later even that portion was still not completed. Over $1.3 million[214] had been spent over five years[215] but no part of the reservoir was yet operational.[216]

Part of the reason for the suspension was undoubtedly that the project had attracted such a large amount of criticism, but this did not account for all of it. More significantly, with the change of leadership the Water Department was now led by someone who saw the project as an outright mistake. McFadden made no secret that he believed it was a blunder to build the reservoir where it was. In a direct swipe at Graff, his immediate predecessor, the first thing McFadden mentioned about the project in his first annual report was that he thought it should have been situated at a much higher elevation and been able to supply virtually the entire city with nearly no supplementary pumping stations or auxiliary reservoirs.[217]

Less than five months later, on 24 Jun 1873, he had called for the convening of a Board of Experts to examine the project, certain that such a panel would wholeheartedly agree with him and recommend abandoning the project.[218] Councils didn't go along, but within two years, McFadden had shut down the project on his own. In 1875, before construction was stopped, he spent only $185 on the project.[219] Despite the recommendation of resumption from a mayoral commission of experts in 1876, no work was performed in 1876 or 1877.[220]

In short, McFadden put the project on the back burner and then shelved it outright. McFadden made this explicit in 1878 when he recommended officially suspending all work on

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[214] The equivalent of approximately $35 million in 2022.
[215] See Annual Reports for 1871 (81),1872 (100), 1873 (91f), 1874 (70f), and 1875 (101).
[216] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 26f; Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 11.
[217] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 26.
[218] Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878), 14.
[219] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 101. The amount was the equivalent of approximately $5,000 in 2022.
[220] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 46f. The commission was convened to provide a comprehensive examination of the city's current and future water supply.

the East Park Reservoir until other proposed system improvements were made, and even then using it only as a sedimentation or subsidence reservoir.[221]

Although McFadden considered the East Park Reservoir a misstep, however, he didn't quite abandon the project completely. Seven years later, in 1882, McFadden spent $250,000[222] on the small basin and on an extension of the connecting mains, but despite the work it still wasn't finished.[223]

On 7 Jun of the same year Councils authorized the mayor to convene the Board of Experts McFadden had first requested nine years earlier and charged the panel with examining the water system and making recommendations that included cost estimates. The mayor appointed McFadden, Graff, E.S. Chesbrough,[224] and J. Vaughan Merrick.[225] The board met for the first time on 19 Sep and submitted its report on 14 Oct. The board described an overall system strained to its limit with no reserve capacity. Citing the rate of increase in peak demand, the board predicted that by the next year two thirds of the city's population would experience water shortages and by 1884—less than two years in the future—the entire city would see the same.[226]

Ominously for the Fairmount Water Works, the board thought that its water powered operations could not be relied upon, declaring, "the time has come when it is necessary to face the fact that during periods of least flow of water, which are also those of greatest consumption,

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[221] Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878), 14.
[222] The equivalent of approximately $7.3 million in 2022.
[223] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 50.
[224] As designer of the Boston water system and Chicago sewer system, Chesbrough was a preeminent hydraulic engineer of national repute. See "Ellis Sylvester Chesbrough," *Proceedings of the American Society of Civil Engineers,* Vol. XV, Nov–Dec 1889 (New York: 1889), 160ff.
[225] Merrick was a prominent local engineer and industrialist. His father was industrialist Samuel Vaughan Merrick, founder of the Southwark Foundry, first president of the Pennsylvania Railroad, and co-founder of the Franklin Institute. See Thomas F. Rzeznik, *Church and Estate: Religion and Wealth in Industrial Era Philadelphia* (Pennsylvania State University, 2013), 161.
[226] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 151.

the water power at Fairmount is practically unavailable."[227] Pointedly absent from the board's report was any recommendation of expansion at Fairmount.[228] Among its recommendations were expansion of steam operations, additional connecting mains for movement of water between the various distribution subsystems, construction of a reservoir at 30th and Cambria Streets, expansion of the Mt. Airy Reservoir, and installation of an interceptor sewer along the east side of the Schuylkill River.

Likely to McFadden's dismay, the board also recommended completion of the East Park Reservoir—as soon as possible. [229]

The board provided an updated cost estimate for finishing the project—nearly $1.2 million,[230] including $400,000 for the first two of the three internal basins, $300,000 for the third basin, $126,000 for mains connecting pumping stations to the reservoir, and $371,000 for mains connecting it to the distribution system.[231]

In 1883 McFadden proposed restructuring the distribution system. Under his plan, which was adopted in its essentials, water from the Fairmount Water Works and Spring Garden Works[232] would be pumped to the East Park Reservoir which would be used as a settling basin. From the East Park Reservoir, water would be pumped to the Fairmount, Schuylkill, Corinthian Avenue, and Lehigh Avenue Reservoirs.[233] The Fairmount Reservoir would then supply the area of the city south of South Street and West of Broad Street. The Corinthian Avenue Reservoir would supply the area south of South Street and East of Broad Street. The Corinthian Avenue, Schuylkill, and Lehigh Avenue Reservoirs would together supply the area of what is today called

[227] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 152.
[228] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 151ff.
[229] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 153f.
[230] The equivalent of approximately $34.8 million in 2022.
[231] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 154.
[232] The Schuylkill Works was known as the Spring Garden Works after 1876.
[233] As implemented, however, water was not pumped back to the Fairmount Reservoir.

Center City, between Vine and South Streets and between the Delaware and Schuylkill Rivers and an area northeast from Center City to Frankford Creek.

The area between of Vine Street and the lower elevations of Manayunk and Germantown, and most of Northeast Philadelphia, would be supplied by a combination of the new Wentz Farm Reservoir (situated between the Lawndale and Crescentville neighborhoods in northeast Philadelphia) and the proposed reservoir at 30th and Cambria Streets. Roxborough and the higher elevations of Manayunk and Germantown would be supplied by the Roxborough and Mount Airy Reservoirs. West Philadelphia would continue to be supplied by the Belmont Reservoir.[234]

As McFadden handed the baton to his successor, William Ludlow, in 1883, hardly any work had been performed on the East Park Reservoir for nearly eight years. While Ludlow decried the fact that the unfinished project "still lies an empty waste,"[235] he believed construction of the reservoir at 30th and Cambria was a greater priority. At a projected capacity of 210 million gallons it would be far smaller than the 700 million-gallon East Park Reservoir and at 166 feet above City Datum its higher elevation would allow it to directly supply a much greater area of the city.[236] For the same reason Ludlow thought expansion of the Mt. Airy Reservoir was more important as well.[237] He estimated the two projects would cost approximately $500,000 and $225,000, respectively,[238] with neither figures including the cost of property acquisition.[239]

Councils passed an appropriation bill by the end of the year but there was a technical

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[234] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 26f.
[235] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 2.
[236] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 33f.
[237] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 35.
[238] The equivalent of approximately $14.7 million and $6.6 million in 2022.
[239] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 34, 35. In 1886, acquisition of the property at 30th and Cambria Streets was determined to cost $206,513. Eventually the project would be dropped when the capacity was deemed to be not worth the cost. See Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 12, and Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 40f.

snag regarding how the funds were to be spent and the projects were delayed.[240] All of this took time, effort, and money away from the East Park Reservoir project, pushing it back further.

Three years later there was still no action and Ludlow estimated the price tag had risen to $1¼ million[241] and would take two to three years to complete. He repeated McFadden's call to use the reservoir only for subsidence and for backup in case of failure of machinery or mains.[242]

In the spring of 1886 John L. Ogden succeeded Ludlow as Chief Engineer. In an attempt to prevent further deterioration of the work done so far, Ogden performed some rehabilitation work on the unfinished embankments. The work included removing trees from the inner slopes and filling gullies with approximately 1,500 loads of clay and gravel.[243] Ogden estimated the entire project would need another $790,000[244]—including $100,000 for the 60 million-gallon southern basin, $600,000 for the 311 million-gallon northeastern basin and 327 million-gallon northwestern basin together, and $90,000 for the remainder of the connecting mains—and urged completion as soon as possible, beginning with the southern section.[245]

On 4 Apr 1887 a new city charter took effect. It had been enacted by the Pennsylvania state legislature on 1 Jun 1885. Among other things, it reorganized the executive branch of the City of Philadelphia by collecting city agencies into functional units. The Water Department became the Bureau of Water and was placed within the Department of Public Works. The Chief Engineer of the Bureau of Water, also called the Chief of the Bureau of Water, reported to the Director of the Department of Public Works who in turn reported directly to the Mayor.[246]

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[240] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 34.
[241] The equivalent of approximately $39.4 million in 2022.
[242] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 26f.
[243] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 108.
[244] The equivalent of approximately $24.9 million in 2022.
[245] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 11.
[246] *Bullitt Bill, As Adopted By the Legislature of Pennsylvania, June 1, 1885* (Philadelphia: Dunlap Printing Co., 1902); Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 1, 47. There were other similarly

Staying on as Chief of the Bureau of Water, Ogden obtained the funds necessary to complete the southern basin of the East Park Reservoir. From April to August 1887 he accomplished initial preparatory work with Bureau of Water employees ahead of a contractor.[247] Trees saplings had grown up again; their roots, which had penetrated deep into the earthworks, needed to be carefully removed.[248] Embankments had eroded and created alluvial deposits averaging two feet thick up to 50 feet into the interior of the basin. In some locations, the entire inside slope had washed away. Centerlines for the embankments had to be re-established so that the top lines, bottom lines, and slope lines could be re-created.

The contractor began work on 3 Aug 1887. The description in the annual report provides a good idea of the immense amount of work—much of it re-work—which still needed to be done.

> The bottom was lined with concrete five inches thick, mixed in the proportions of one part cement, two parts sand, and four parts broken stone. The best brands of Portland cement, bar sand, and hard lime-stone were used. All cement [concrete] was tested, resulting in an average tensile strain of 340 pounds per square inch, after being allowed to harden in water for seven days. All the sand used was screened. The stone was clean angular, 1½-inch ring stone. The mixings were made on platforms, then evenly spread upon the clay bottom and consolidated by ramming. A covering composed of two parts sand and one part cement was laid on tip of concrete, floated and trowel finished.
>
> The slopes in the entire area were lined with brick set on edge in cement mortar two inches thick, composed of one part cement and two parts sand. The bricks used were hard

organized departments; the Department of Public Safety, for example, was comprised of the Electrical Bureau and the Bureaus of Police, Fire, and Health.

247 Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 54, 121.

248 This is commonly called "brushing and grubbing." Brushing means clearing foliage and above-ground growth. Grubbing means thoroughly uprooting shrubs and trees.

> burned, well shaped and of good wearing qualities. …
>
> A brick curbing 2,500 feet in length was laid in two inches of cement on the top of slopes. The manholes to the stop-chambers on the division banks were raised to the top of the embankments. The stop-houses of this section were cleaned out and bottom repaired and cemented; the walls entirely repointed with cement mortar; the wing walls repointed and repaired and covered with cement copings. The top was set with beams for supporting grating, and brackets for the gate hoists; ten iron gates set with grouted joints of pure Portland cement, and rods put in to operate them from the top of the stop-house; wire screens placed in all communications between basins and the water mains, communication between the two basins shut off by a heavy plank bulk head of two thicknesses, filled between with cement. The brick piers supporting the pipes connecting the several sections were rebuilt and the stops overhauled. The old terra cotta drain of this section of the reservoir was found to be clogged up with clay, and was taken out and a ten inch iron pipe laid, and provided with a new stop. The masonry and brickwork throughout were repaired; a fence of yellow pine was place around the top lf the basin; the office was connected by telephone to the Spring Garden Station by an underground cable laid in a wooden box built for it and run into the trench of the pumping main.[249]

The contractor finished on 19 Nov, allowing water to be admitted eleven days ahead of the stipulated completion date.[250] The cost came in at $100,221,[251] just over Ogden's estimate a year earlier.[252] A portion of the East Park Reservoir was finally useable.

Ogden recommended completion of the northeastern basin next and made arrangements to continue work "as soon as the weather permits."[253] He now estimated this portion would cost

[249] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 122.
[250] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 54, 122.
[251] The equivalent of approximately $3.1 million in 2022.
[252] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 108f.
[253] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 41.

$400,000.[254] Work got under way on 2 Apr 1888 and water was pumped in on 23 Oct. As with the southern basin, grading and puddle lining was performed by Bureau employees and the concrete and brick work was done by a contractor. The cost came to $405,837.[255]

Now that over half of the East Park Reservoir had been completed, it could be used as a subsidence and sedimentation basin. In order to maximize the cleanliness of the water distributed from it, water was not pumped into it during and after freshets until the turbidity of the Schuylkill River had passed. This also resulted in less sediment buildup in the reservoir, less silt in the mains, and less wear and tear on the pumps.[256]

The northwestern basin was the last to be completed. Parts of this basin needed the most work of all three, having lain incomplete and exposed to the elements for nearly fourteen years. Work started on 2 Feb 1889.[257] The cost of completing it was $361,668,[258] somewhat less than for the northeastern basin, partly because it was a little smaller and partly because portions of its embankments had been improved during work on the other two basins.[259]

At four o'clock in the afternoon of Tuesday, 8 Oct 1889,[260] a formal opening ceremony was held at the reservoir.[261] The event involved approximately 450 dignitaries including Mayor Edwin H. Fitler, his guest John Mark (the Mayor of Manchester, Great Britain), Director of Public Works Louis Wagner, Chief Engineer Ogden, Select and Common Council members

[254] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 7. The amount was the equivalent of approximately $12.5 million in 2022.
[255] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 133, 144. The amount was the equivalent of approximately $12.7 million in 2022.
[256] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 99.
[257] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 144.
[258] The equivalent of approximately $11.6 million in 2022.
[259] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 83, 86.
[260] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 87.
[261] "On the Basin's Big Bank: Politicians Gather and Watch the Water Flow," *Philadelphia Evening Star* (Wednesday 9 Oct 1889); "The Big Reservoir: Mayor Fitler and City Fathers Inspect the Last Section," *Philadelphia Inquirer* (Wednesday 9 Oct 1889), 2.

from virtually all wards, other department directors, and numerous other state and city officials and judges. With the next election a little over a year away there were also candidates for mayor, City Councils, various and sundry elective city offices, and the United States Congress. The crowd was swelled with political veterans and newcomers alike. Frederick Graff, Jr., was included with particular honor.

A majority of the participants had boarded a special seven-car train which departed from the Pennsylvania Railroad's Broad Street Station at three o'clock and dropped the passengers off at the Engleside Station.[262] Located just to the northeast of the location at which 33rd Street crosses Amtrak's Northeast Corridor today, Engleside was a combined passenger and freight station which served the huge Bergner & Engel Brewing Company and numerous other breweries in the area.[263] Although it was the closest station to the reservoir, it was located on the south side of the rail line and designed for workers and freight heading southeast toward the breweries, not toward the northwest where the reservoir was located. After crossing the tracks, all of the attendees had to pass single-file through an 18-inch-wide temporary opening in the fence surrounding the property. Some of the more overweight among the crowd, such as Mayor Fitler, had a hard time squeezing through the inadequate opening, while colleagues and friends good-naturedly poked fun at each other. Eventually, Director Wagner enlarged the opening himself.

Once through the fence the crowd walked toward the northwest, diagonally across a field in the corner of the East Park just west of 33rd Street, toward the southern end of the East Park

[262] Sometimes spelled *Engelside*, the station was demolished in 1903. See Dan West, "Philadelphia County," *Pennsylvania Railroad Stations Past and Present* (1999–2020), <https://www.west2k.com/pastations/philadelphia.shtml>, accessed 2 Mar 2020.

[263] The breweries are long gone, most having succumbed to Prohibition, but the area to the southeast of the former location of the station is still called Brewerytown.

Reservoir's northwestern basin. The throng climbed to the top of the embankment and descended the inner slope of the still-empty basin along a long wood stair installed for the occasion. The crowd paused to assemble for a photograph[264] and exchange mutual congratulations,[265] then proceeded in small groups onto the floor of the basin. Some began to pretend to dance together.

Director Wagner called, "Turn the water on!" to Superintendent Frank L. Hand atop the embankment; with a wave of Hand's handkerchief workers turned valves and water flowed from the northeast basin through four large connecting sluice pipes into the northwest basin. Some among the crowd had to hurry back to the wood steps to avoid getting caught by the water spreading across the floor of the basin.

After returning to the Broad Street station by the same train that brought them, the entire group walked three blocks to St. George's Hall at 13th and Arch Streets for a celebratory dinner paid for by the two main contractors, Ludwig S. Filbert's Filbert Paving & Construction Company and Charles A. Porter's Vulcanite Paving Company. Favored by the political machine, Filbert and Porter could afford such largess. They footed the bill for a 14-course banquet served on long tables lushly decorated with roses and tropical plants while an orchestra serenaded the diners from a balcony. Wine and liquor—including wine from northern Italy, Burgundy, champagne, sauterne, sherry, and brandy—flowed like the Schuylkill during a freshet. City Solicitor Warwick congratulated Wagner on being a teetotaler, but praised water "as the basis for good wine," and noted that there was "water—water, everywhere, but not a drop to drink—here!"[266]

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[264] Unfortunately the search for the photograph has been fruitless.
[265] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 87; "On the Basin's Big Bank: Politicians Gather and Watch the Water Flow," *Philadelphia Evening Star* (9 Oct 1889).
[266] "The Big Reservoir: Mayor Fitler and City Fathers Inspect the Last Section," *Philadelphia Inquirer* (Wednesday 9 Oct 1889), 2. Warwick was referring to Samuel Taylor Coleridge's "Rime of the Ancient Mariner" of 1798.

Governor Beaver stopped by, but he and Mayor Fitler stayed for only a short while. The governor left to catch his train back to Harrisburg and the mayor begged off by claiming he was too ill to remain. This was probably prudence on both their parts; they could probably detect early on how the evening was likely to proceed. By the time a handful of speakers attempted to deliver their speeches, in fact, most of the assembled guests were decidedly less than sober. Between the genuine pleasure and excitement of having finally completed the long overdue landmark reservoir and the lubricating effects of the plentiful alcohol, the multitude cheered and brayed so loudly and incessantly that none of the speeches could be heard. Wagner valiantly attempted to speak for thirty minutes but finally had to give up. Others, including Fitler, Graff, and the district attorney, tried as well but surrendered after only a few minutes each. In the end the wiser among the crowd had fled and Wagner finally adjourned the event.

Boss politics insisted on inserting itself into the event. The uninvited James McManes, by now in the waning days of his influence, crashed the event, forcing the seating arrangement to be changed in order separate him from his opponents.

Still, after much controversy, funding difficulties, and temporary abandonment, the East Park Reservoir was finally complete and operational. The total cost was nearly $2.2 million,[267] not including that of the connecting mains.[268] Despite the "urgent necessity"[269] for additional storage the facility was designed in 1869 to answer, it took twenty long years to finish, eighteen since construction had begun. One can almost hear a weary sigh of relief from Director of Public Works Wagner as he later recorded:

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[267] The equivalent of approximately $70 million in 2022.

[268] Mains connecting the Spring Garden Works to the East Park Reservoir were completed in 1876 at a cost of $25,329. See Water Department, *Chief Engineer's 1876 Annual Report* (2 Oct 1877), 51. Connecting mains from the East Park Reservoir to the Lehigh Avenue Reservoir would be completed in 1890 at a cost of $48,915. See Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 166f.

[269] Graff, Jr., to Louis Wagner, Director of Public Works, 24 Oct 1889, published in Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 88.

> Thus, after more than twenty years from the inception of this work, after much adverse criticism of the plans, and more of the manner in which the work under them was prosecuted, and which brought about a total cessation of work for many years and almost its entire abandonment, one of the largest reservoirs built with artificial banks from bottom to top was finally finished, ready for use, in a little more than two years from the time when the work passed under the control of this Department.[270]

With all of the connecting mains in place, five of the Fairmount Water Works' seven turbines (Wheels 4, 5, 7, 8, and 9) now pumped directly to the East Park Reservoir. Any or all of the steam engines at the Spring Garden Works[271] pumped into it as well. After settling there, water was then pumped to the Corinthian Avenue Reservoir or directly into the distribution system.[272]

Prior to the construction of the East Park Reservoir, Philadelphia's total reservoir capacity was a little over 195 million gallons, representing approximately two days' supply. With the new reservoir the total capacity increased to nearly 900 million gallons.[273] Although there were still areas of the city that depended upon direct pumpage,[274] the new reservoir provided a reserve capacity equal to 14 days' supply for a majority of the city's population.[275] During 1889 the turbines at Fairmount were shut down for the equivalent of over 188 days

[270] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 87.
[271] The Spring Garden Works was known as the Schuylkill Works from 1854 to 1876.
[272] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 143. Wheels 1 and 3 pumped directly to the Fairmount Reservoir.
[273] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 81.
[274] Specifically, the 15th, 28th, 29th, and 32nd Wards and half of the 20th Ward. Bounded roughly by Vine Street to the south, Lehigh Avenue to the north, the Schuylkill River to the west, and Broad Street to the east, this area was ironically the closest to the East Park Reservoir. See Bureau of Water, *Chief Engineer's 1891 Annual Report* (30 Jan 1892), 70.
[275] The East Park Reservoir supplied the area of Vine Street to South Street and between the Delaware and Schuylkill Rivers, north of Vine Street and east of Broad Street to Jefferson Street, east of 9th Street to Lehigh Avenue, and south of Lehigh Avenue to Kensington Avenue. Graff, Jr., to Louis Wagner, Director of Public Works, 24 Oct 1889, published in Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 89; Bureau of Water, *Chief Engineer's 1891 Annual Report* (30 Jan 1892), 69f.

because the reservoirs they fed were full. The following year the wheels were stopped for the same reason for the equivalent of only eight days.[276]

[276] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 143. The turbines were stopped for 4,533 hours in 1889 and 192 hours in 1890.

CHAPTER 9

TROUBLE ON THE HORIZON

The Fairmount Water Works was riding high. In 1877, for example, pumping capacity was nominally 40,000 gallons per day. Never mind that this was rarely if ever actually achieved.[1] Fairmount contributed over half of the city's water supply and over sixty percent of the water drawn from the Schuylkill River. Its future looked bright. It wasn't obvious yet—it would take time—but here and there the seeds of decline were beginning to sprout. Eventually they would fully flower.

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Of immediate concern to William F. McFadden was the perennial lack of funds to make necessary improvements or maintain the system the way is needed to be. In 1878, five years after he became Chief engineer, he noted that although the Water Department produced revenue greatly exceeding its expenses, it always went begging for funds. Instead of treating the Department as a cash cow for the general fund, he pleaded with Councils to allow the Department to redirect its own revenues to "place the City beyond a short supply and the contingency of a large conflagration." In this way he could definitively address the issues of "power, storage and enlarged means of distribution." While operational concerns were uppermost, the buildings and grounds were also suffering from reduced funding for maintenance

[1] Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878), 62.

and upkeep.[2] Protesting that as "the head of a department" he could only do so much without funding from Councils, it seems McFadden expected his hortatory appeal to fall on deaf ears—which it did.[3] The following year McFadden observed that the railroads, another industry with high infrastructure costs, typically expended 60 percent of their gross receipts[4] on maintenance, but Council's stinginess with the Department's own revenues forced it to spend only 30 percent.[5]

When McFadden was elected Chief Engineer in the spring of 1873, at Fairmount he first completed the renovation of Fairmount Dam and the lengthening of the Pier between the overfall portion of the dam and the Mound Dam. He next turned his attention to the turbines and pumps. While those in the Old Mill House were brand new, those in the New Mill House were now a little over ten years old.

McFadden had all six of the pumps in the New Mill House re-bored, using a portable boring machine operated by workers from the L. B. Flander's Machine Works.[6] Solid pistons were installed in place of the original wood packing, increasing the capacity of the pumps.[7] In 1878, new yokes were installed on the pumps.[8] Four years later the bearings in Turbines 7 and 8 were repaired.[9]

Although relatively new, the turbines in the Old Mill House were not without their maintenance demands. The piston rods for the pumps, for example, were found to be loose and

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[2] Water Department, *Chief Engineer's 1881 Annual Report* (2 Mar 1882), 11f. As an example, McFadden observed that because of a lack of funds for contract work, the painting of the tin roofs and all of the machinery had to be performed by the Fairmount foreman and site employees.
[3] Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 12. If a department head were allowed to control so large a pot of money, moreover, it would not be available for use by the political machine.
[4] The entire income, not merely profit after expenses are paid.
[5] Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 19.
[6] *The American Engineer,* Vol. 5, No. 23 (Chicago: Merrick Cowles, 8 Jun 1883), 305; *The Official Railway List* (Chicago: Railway Purchasing Agent Co., 1886), 14. Flander's was a successful Philadelphia machine shop that specialized in servicing pumps and locomotives.
[7] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 7f.
[8] Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 15.
[9] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 93.

were properly tightened.[10] Turbine 3, which had begun operating in 1869, needed its lignum vitae bearing replaced in 1873.[11] All of the turbines' bevel gears had wood teeth which often needed to be replaced or repaired. The teeth on the gears of Turbine 9, for example, broke and required replacement in 1873.[12] Those on Turbine 8 required renewal in 1874[13] and complete replacement in 1879.[14] In 1874 those in the bevel gears of Turbines 4 and 5 were replaced, even though they were only four and three years old, respectively.[15]

The Fairmount Reservoir had its share of issues. During a severe, four-day rainstorm in late September 1882, for example, 11.675 inches of rain fell and the saturation of the ground resulted in slides in three places along the exterior slopes. Repairs were made and the slopes were re-graded and re-sodded at a cost of $1,500.[16]

The grounds needed continual work as well. McFadden in 1874 proposed replacing the existing wood fence with an iron balustrade along the top of the South Garden's river wall above the Esplanade from the Engine House south to the Wire Bridge. This was accomplished shortly after.[17] The same year he had the park benches that were scattered throughout the grounds repaired and repainted, and augmented them with an additional one hundred. He also painted the iron railings along the cliffside paths and reservoir embankment walkways.

Although the telegraph had been in existence for thirty years, and a transcontinental line had been operating for some ten years, when McFadden became Chief Engineer the Water

[10] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 7.
[11] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 7.
[12] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8.
[13] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12.
[14] Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 14.
[15] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12.
[16] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 18, 19, 90. The amount was the equivalent of approximately $43,600 in 2022.
[17] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8. The wood fence must have been replaced with the iron balustrade early enough after McFadden's recommendation that by 1885 it needed to be "partially repaired." See Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.

Department had yet to take advantage of the advance in technology. For even the most urgent of communication, a courier had to be dispatched. This slow pace often caused problems. In 1874 McFadden saw to it that a telegraph system was finally installed. He described three immediate benefits: command and control of the entire system, rapid response to failures or other problems, and ease of centralized record keeping.[18] The system soon proved its worth, with McFadden reporting in subsequent years the volume of message traffic and numerous issues to which the Department was able to quickly respond.[19] Experience with the telegraph taught McFadden the value of rapid communication and in early 1882 he requested funds for a telephone system—calling it a "necessity"—but the request was denied.[20]

The same year the telegraph system was installed, McFadden directed the Department to begin keeping a record of all "reasonable ground of complaint." Customers were provided forms they could mail in or drop off. This seems intended to be both a check on Department employees who were ignoring issues and the creation a so-called "paper trail" to prevent a customer from later claiming they had submitted a complaint which they had not.[21]

Charles Ellet's Wire Bridge, located just downstream of Fairmount, was a groundbreaking engineering achievement when it was built in 1842 but by the early 1870s it had become overwhelmed by the demands placed upon it by a steadily increasing amount of traffic. The upcoming centennial celebration was expected to make the situation even worse. Construction on a replacement, called the Callowhill Street Bridge, was begun in 1874. Designed

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[18] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 24.
[19] For example, Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 63f; Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878), 17f; Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 19; Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 21; Water Department, *Chief Engineer's 1880 Annual Report* (1881), 27; Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 16.
[20] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 16.
[21] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 26. One naturally wonders what the definition of "reasonable" was and who decided; the record is silent on both counts.

by Jacob H. Linville, and innovative in its own right, the new bridge featured a double-deck design.[22] McFadden moved Graff's iron fence at the south end of the South Garden fifty feet to the north in order to allow room for its construction.[23]

In order to accommodate the eastern approach of the upper roadway, the City of Philadelphia gave the builders permission to make a twenty-foot vertical cut in the southern embankment of the Fairmount Reservoir. In March of 1874 McFadden fretted that the excavation not only marred the beauty of the grounds but could potentially result in a failure of the exterior slope of the reservoir.[24] Less than a month and a half later his fears were realized; the slope gave way, with the slide reaching to within 45 feet of the top of embankment. To prevent a catastrophic breach, McFadden drew down the water in the reservoir.[25]

In the midst of the problem, however, McFadden saw an opportunity. With the water low by necessity, it was the perfect time to clean the reservoir. Last done in 1852, the muck accumulated since then was found to be eighteen inches deep. When the project was finished, nearly 6,000 cubic yards of material had been removed.[26]

The single steam engine at the new Frankford Works on the Delaware River broke down on 15 Jul 1878. Operating since the previous December, the engine supplied water to residents throughout northeast Philadelphia via the Wentz Farm Reservoir at Rising Sun Avenue and Comly Street, between the Lawndale and Crescentville neighborhoods. Since the auxiliary

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[22] James Baughn, "Callowhill Street Bridge," *Bridgehunter* (2020), <http://bridgehunter.com/pa/philadelphia/callowhill-street/>, accessed 10 Nov 2020; "Callowhill Street Bridge," *Library of Congress* (2020), <loc.gov/item/pa0900/>, accessed 10 Nov 2020. The Callowhill Street Bridge was a 350-foot-long wrought iron Whipple truss. Decorative cast iron arches were removed around 1900 and the railings by 1910.

[23] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13.

[24] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8.

[25] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13.

[26] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13. The material wasn't wasted but was instead used to raise the grade in certain places in the Flat Iron, the area just to the north, between Fairmount and Lemon Hill. See Fairmount Park Commission, *1878 Annual Report* (May 1878), 58.

Worthington duplex steam engine in the ornamental building near the wharf above the Forebay had been sitting unused since 1876, McFadden hurriedly removed it, transported it over to Frankford, overhauled it, and married it to a new boiler. The reliable little engine began pumping at Frankford ten days after the breakdown and labored there continuously as the lone engine and pump until the primary engine was repaired and resumed its work the following May. At Fairmount, the engine's old boiler was abandoned in place for the time being.[27]

In 1878 McFadden assembled a team of experts to evaluate the performance of Fairmount's turbines. Conducting tests during October, the team determined that Wheel 9, in the New Mill House, used 28 gallons of water to pump one gallon to the Corinthian Avenue Reservoir and had an efficiency of 30.3 percent (averaging performance at all tidal levels). Wheel 7 used 38.6 gallons to pump one gallon. When Wheel 4, in the Old Mill House, was tested, it was found to require 38.6 gallons to pump a single gallon to the Fairmount Reservoir at high tide and 37 gallons to do the same at low tide. In either circumstance, the turbine was found

[27] Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 18; Water Department, *Chief Engineer's 1879 Annual Report* (229 Apr 1880), 17. After 3 May 1879, the 2-million-gallon-per-day-capacity Worthington duplex engine served as a backup at Frankford until it was removed to make room for a larger main engine which began operating on 5 Aug 1884. The Annual Report for 1884 states that the engine was condemned and sold that year, but perhaps not. It appears to have been brought out of retirement eleven years later for use at the Belmont Auxiliary station, a high service station used to improve water service from the George's Hill Reservoir to the western, higher portions of the 34th Ward in West Philadelphia. From 1895 to 1898 the engine again served as the lone engine and pump at its location. In 1908 it was replaced by a larger engine. The engine does not again appear in the record, but the Annual Report for 1908 lists five sales of "old material" for moderate sums to four different companies, two of which were confirmed scrap iron concerns (Park Iron Yard Co. and H. A. Hitner's Sons). It seems likely that, completely worn out by that time, the little Worthington duplex which had valiantly served since 1868 wherever it was needed, first at Schuylkill, then the 24th Ward Works, Fairmount, Frankford, and lastly at Belmont Auxiliary, was finally condemned and sold for scrap. See Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 191; Bureau of Water, *Chief Engineer's 1894 Annual Report* (Jan 1895), 24, 69; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 44, 74, 75, 80; Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 64f; Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 82; Bureau of Water, *Chief Engineer's 1898 Annual Report* (20 Jan 1899), 52; Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 69; Bureau of Water, *Chief Engineer's 1908 Annual Report* (1 Jan 1909), 124, 125, 127; "H. A. Hitner's Sons Co. Give Up New York Offices," *The Waste Trade Journal*, Vol. VIII, No. 15 (New York: Atlas Publishing Co., 8 Jan 1910), 5; Walter A. Graf et al., "The Belmont Works," "Frankford Pumping Station," *The Water Works of the City of Philadelphia: The Story of their Development and Engineering Specifications* (19 Nov 1957), *Philly H_2O*, <http://www.phillyh2o.org/backpages/GrafHistory_HSP.htm#Chapter10>, accessed 14 Aug 2020.

to be 22.5 percent efficient.

In an experiment during the winter of 1878–1879, the rotor of Wheel 4 (the middle turbine in the Old Mill House) was replaced with a duplex rotor with an automated inlet gate. The duplex wheel was designed by Emile Geyelin to automatically compensate for the varying head of water as the tide rose and fell in the Schuylkill River below Fairmount Dam. The work began on 4 Nov 1878 and continued into the following year. When the modification was found to have increased the turbine's output by 40%,[28] duplex rotors were installed in the other two Old Mill House turbines shortly after.[29]

On 4 Jun 1880, one of the flanges on the shaft of Turbine 4 broke and threw the shaft out of line, destroying the hoist system for the duplex wheel's automated inlet gate in the process. The mangled machinery was removed and the shaft repaired, but without the automated gate the turbine had to be run using only the outer portion of the duplex wheel.[30]

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When McFadden first walked through the door of his office in 1873, planning was well under way for a world's fair in Philadelphia in 1876.[31] The Centennial International Exhibition was intended to celebrate the one hundredth anniversary of the Founding and be a grand showcase for the technological and industrial growth of the nation. American states and foreign

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[28] Water Department, *Chief Engineer's 1878 Annual Report* (19 Jun 1879), 15; Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 14.

[29] Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880), 14. When City Councils failed to appropriate funds for the duplex apparatuses in a timely fashion, McFadden paid Geyelin out of an account set aside for equipment repair. When the account was exhausted, Geyelin halted work on the second installation and submitted an invoice which read that he "would perform the balance of the work as soon as that already done had been approved." See "The Water Committee," *Philadelphia Inquirer* (21 May 1879), 2.

[30] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 27.

[31] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 459ff.

countries were invited to join the celebration by contributing representational pavilions. Businesses and organizations of all sorts were encouraged to participate with creative exhibits and demonstrations.

The idea was conceived in a letter sent in 1866 from Professor John L. Campbell of Wabash College in Indiana to Morton McMichael, Mayor of Philadelphia at the time. By 1870 the Franklin Institute was supporting the idea and local business leaders got behind it as well. Congress created the United States Centennial Commission in March 1872 and appointed a congressman from Connecticut as its president. The same year Congress also created the Centennial Board of Finance to sell stock in order to raise money for the enterprise. John Welsh, a Fairmount Park Commissioner, was chosen to head the board. Both the City of Philadelphia and the Commonwealth of Pennsylvania contributed funds.[32]

The Fairmount Park Commission designated 236 acres within the park on the west side of the Schuylkill River for the grounds.[33] Construction on the Main Exhibition Building was begun in 1874. Designed as a temporary structure, it was over 1,800 feet long and covered over 21 acres; it was the largest building in the world at the time. Next to it the similar Machinery Hall was over 1,400 feet long. The granite-clad Memorial Hall, a permanent building intended as an art museum, rose nearby; across a narrow valley the multi-hued brick Horticultural Hall was being built.[34] In all, over two hundred buildings would be part of the complex. The City of

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[32] United States Centennial Commission, *International Exhibition: Fairmount Park, Philadelphia, 1876* (Philadelphia: Feb 1875); Pennsylvania Board of Centennial Managers, *Pennsylvania and the Centennial Exposition: Preliminary and Final Reports,* Vol. I (Philadelphia: Gillin and Nagle, 1878), 83ff.

[33] Roughly the location of the former Lansdowne and George tracts.

[34] Horticultural Hall was intended to be a permanent fixture as well but after decades of neglect was demolished shortly after being damaged by Hurricane Hazel in 1954. Of the major buildings, only Memorial Hall is extant. For decades it housed the offices of the Fairmount Park Commission. Since 2008 it has been the home of the Please Touch Museum, a popular children's museum and activity center. A permanent interpretive exhibit on the Centennial is located on the museum's lower level. Well worth a visit, the exhibit features an historic scale model of the Centennial grounds, created thirteen years after the Centennial as a permanent physical record.

Philadelphia provided water to the Centennial Commission during the construction phase free of charge.[35]

In response to the large numbers of visitors which were expected, numerous hotels and restaurants were constructed in the vicinity. The Pennsylvania Railroad erected a three-platform passenger station and head house across the street from the main entrance. The Philadelphia and Reading Railroad built its own special station along the Schuylkill River.

McFadden in 1874 worried about supplying the fair with water. The area west of the Schuylkill River was supplied by the Belmont Works, located nearby on the west bank of the river just below the Columbia Bridge. Designed by Frederic Graff, Jr. and operating since 1870, it pumped water about three quarters of a mile up to the George's Hill Reservoir, 208 feet higher in elevation than the river and situated on a high point overlooking the location of the fair grounds.[36] The three Worthington duplex steam engines at the Belmont Works together pumped approximately 18 million gallons per day. McFadden estimated that an additional 20,000 gallons per day would need to be supplied to the fair and recommended expanding the capacity with additional machinery and mains,[37] but Councils ignored his suggestion.

The Centennial Commission realized that water needed to be provided to the Exhibition independent of the city's supply system. It hired Graff, now working with Henry R. Worthington, to design and construct a self-contained water supply and sewerage system. Graff devised a system which included a pumping station, standpipe, distribution mains, and all fixtures and accessories—everything except the design of the pumping engines and boilers

[35] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 57.
[36] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 39.
[37] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 15.

themselves.[38]

The engine house was situated on the west bank of the Schuylkill River about a third of a mile downstream of the Philadelphia Water Department's Belmont Station, but was not connected with it in any way.[39] A one-story brick building, 70½ feet long by 39½ feet wide, with an 80-foot chimney, it was divided internally into an engine room and a boiler house. Two boilers, each 18 feet long and 6½ feet in diameter, powered a Worthington duplex steam engine with a capacity of 5.5 million gallons per day. An auxiliary engine with a capacity of 1 million gallons per day was held in reserve, intended "for temporary use, in case of any accident" with the Worthington engine. Henry R. Worthington donated the duplex engine for use during the Exhibition free of charge as an exhibit of its own.

A 75-foot-long 30-inch inlet main drew water by gravity from the Schuylkill River into a well in the engine house. From the well, two pumps driven by the Worthington engine forced water through a 958-foot-long, 18-inch ascending main up to a standpipe just to the north of Memorial Hall.

The wrought iron standpipe was 4 feet in diameter and 120 feet tall, with an additional 13-foot decorative finial at the top. It had an octagonal masonry surround on the lower 25 feet composed of green serpentine trimmed with Ohio sandstone. The water level within topped out at 108 feet above the floor level of the Main Exhibition Building and Machinery Hall and 208 feet above the level of the Schuylkill River.[40] A 1,300-foot, 16-inch distribution main led from

[38] "The Pumping Engines," *Scientific American Supplement,* Vol. II, No. 15 (New York: 8 Apr 1876), 232f; "Water, Drainage, and Gas," *Pennsylvania and the Centennial Exposition: Preliminary and Final Reports,* Vol. I (Philadelphia: Gillin & Nagle, 1878), 115. See also *Proceedings of the American Society of Civil Engineers,* Vol. XVII (Aug 1891), 247.

[39] H. J. Schwarzmann, Chief Engineer, *International Exhibition, Philadelphia, 1876: Situation Plan* (New York: The Graphic Company, 1876), collection of the Fairmount Park Historic Resource Archives.

[40] Not coincidentally, this was also the level of the water in the George's Hill Reservoir, to which the Belmont Station pumped.

the standpipe to a point in the middle of the Exhibition, from which a distribution network of 12- and 10-inch mains spread out across the Exhibition grounds. In addition to providing water to all of the buildings and fountains, the distribution system also supplied approximately 300 fire hydrants and the water of Centennial Lake.[41]

McFadden was rather skeptical of Graff's design, suspecting it incorporated insufficient storage capacity. With the City finding it difficult enough to provide sufficient water to its residents as it was, he made it clear that if there were a shortfall on the grounds, the Department's first priority would not be to the Exhibition.[42]

The crowds turned out. Between 10 May 1876, when President Grant officially opened the celebration, and the closing on 10 Nov, attendance totaled nearly ten million, a huge number when the entire population of the country was less than forty million and the city of Philadelphia contained less than 700,000.[43] Although there were between 36,000 and 186,000 visitors on any given day—and the area experienced a heat wave from June through August—Graff's system provided plenty of water.

McFadden had thought the Centennial Exhibition would need 20,000 gallons per day while it was under way. Graff's system produced an average of nearly 2.2 million gallons per day, over one hundred times McFadden's estimate. The Worthington engine had such an excess of pumping capacity that it could more than keep up with demand and the auxiliary engine held

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[41] There was one exception. The Catholic Total Abstinence Union's fountain, at the western end of the Exhibition grounds, was not connected to the Centennial Exhibition's distribution system but was instead fed independently from the Water Department's nearby George's Hill Reservoir via a 937-foot-long 10-inch connection. See Water Department, *Chief Engineer's 1876 Annual Report* (2 Oct 1877), 100; H. J. Schwarzmann, Chief Engineer, *International Exhibition, Philadelphia, 1876: Situation Plan* (New York: The Graphic Company, 1876), collection of the Fairmount Park Historic Resource Archives.

[42] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 57.

[43] "The Exhibition of 1876: Some of the Results," *Scientific American Supplement,* Vol. II, No. 52 (New York: 23 Dec 1876), 820f; "POPCulture: 1870," *U.S. Census Bureau,* <www.census.gov/history/www/through_the_decades/fast_facts/1870_fast_facts.html>, accessed 5 Jun 2020.

in reserve as a backup eliminated the need for a storage reservoir.[44]

With abundant water to spare, the system could even supply a lavish indoor fountain display. Located in its own facility projecting from the south side of Machinery Hall, it featured a 50,000-gallon basin 146 feet long, 60 feet wide, and over 6 feet deep. Jets of water arced over the basin and a 32-foot-high, 40-foot-wide wall of water fell in a continuous deluge at the far end at the rate of 18,000 gallons per minute.[45] It was spectacular for its day.[46]

Graff's water supply system was a smashing operational triumph, on an international stage. It was likely no small source of professional and personal satisfaction that it depended completely on the type and size of engine that had got him in such trouble just six years earlier—the Worthington duplex condensing steam engine.

It is interesting to note that except for a single line item referring to the connection for the Catholic Total Abstinence Union Fountain, buried in a long list of distribution mains laid during the year,[47] McFadden didn't mention the Centennial in his annual report for 1876 at all. This seems odd. Was it an expression of professional pique toward a man who already cast a long shadow over the Water Department, or disappointment in having virtually no direct involvement in such a momentous event? A little of both, perchance? Possibly neither; with the Centennial system being completely independent of the City's water supply, perhaps there was simply

[44] There is no indication the auxiliary engine was ever used.
[45] "Hydraulics At the Exhibition: The Pump Annex," *Scientific American Supplement*, Vol. II, No. 44 (New York: 28 Oct 1876), 687; "The Great Cataract of the Centennial," *Scientific American Supplement*, Vol. II, No. 52 (New York: 23 Dec 1876), 819. The two articles give contradictory information on the details of some of the dimensions. This author-editor has elected to use the more conservative figures.
[46] This fountain display impressed six-year-old Pierre S. du Pont enough that it became a foundational inspiration for his creation of the renowned Longwood Gardens fountain displays decades later. See "History: Pierre S. du Pont, 1870–1954," *Longwood Gardens* (2020), <https://longwoodgardens.org/history/1870-1954>, accessed 10 Nov 2020.
[47] Water Department, *Chief Engineer's 1876 Annual Report* (2 Oct 1877), 100.

nothing of relevance to the Water Department to report.[48]

One exhibit at the Centennial Exhibition presaged an aspect of Fairmount's future—the hand and torch of Frédéric Auguste Bartholdi's great statue, *Liberty Enlightening the World,* or the Statue of Liberty as it would of course come to be known. The Fairmount Water Works had been one of the early symbols of the nation, and still was to a great extent. It was impossible to know at the time, but a portion of one of the things that would eventually displace Fairmount as a national icon was on display that summer, just upstream and across the river.

Possibly in anticipation of increased numbers of visitors to the Fairmount Water Works expected as a spillover effect of the Centennial Exhibition, in early 1874 McFadden recommended the pitched roof over the area of Turbine 1, in front of the Engine House and between the Engine House and the Old Mill House, be replaced by a flat deck at the same level as that of the Old Mill House and be surrounded by the same type of iron balustrade.[49] This would provide an expanded area for visitors to linger and enjoy the river view after purchasing refreshments in the Engine House.

The river wall in front of the Engine House, however, was progressively cracking due to deterioration of the original wood foundation. Before a deck could be built, the wall needed to be reconstructed. In 1874 it was removed, the wood foundation was excavated, and a new river wall was constructed upon a masonry foundation that went down to a depth of twelve feet below low tide. A temporary flat roof was then extended from the porch of the Engine House to the new river wall.[50]

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[48] McFadden could console himself with the knowledge that City Councils had in 1876 lengthened the term of office of Chief Engineer from one to three years, reducing the uncertainty and political turmoil caused by annual re-election. See Water Department, *Chief Engineer's 1876 Annual Report* (2 Oct 1877), 7.
[49] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8.
[50] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13.

Afterward, from late 1880 to early 1881 McFadden constructed a permanent deck over the Turbine 1 area in front of the Engine House. Similar in design to the deck roof of the Old Mill House, it featured wrought iron I-beams supported by wrought iron Phoenix columns and spanned by brick-arch vaults.[51] In 1874 McFadden had recommended skylights be installed over each of the turbines "to facilitate the raising and lowering of heavy machinery."[52] Although this was not done for every turbine, he did construct one in the permanent roof deck above Turbine 1, completed in 1882.[53]

In order to accommodate the expected crowds the fair would bring in the summer of 1876, McFadden added something of lasting benefit that Fairmount had needed for a long while—public restrooms. A ladies room was built just off the great hall on the main floor in 1874. Shortly after, a men's room was constructed one floor down, at the level of the Turbine 1 machinery room.[54]

One of the attractions built by entrepreneurs in an attempt to capitalize on the increase in visitors to Philadelphia during the centennial year is visible in some photographs of the Fairmount Water Works of the era. The Lemon Hill Observatory was an observation tower built on the Lemon Hill grounds, just to the northwest of the mansion and above Boathouse Row. Composed of iron supplied by the Phoenix Iron Company, it was erected by Clark Reeves & Co. for the Philadelphia Observatory Company, which sold public shares of stock to investors.

The tapered tower stood 225 feet tall and rose 310 feet above the river. The base was 55 feet square and the observation deck was 28 feet square. Similar in design to two observation

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[51] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 32; Water Department, *Chief Engineer's 1881 Annual Report* (2 Mar 1882), 12. The four Phoenix columns installed in this area in 1881 are some of the oldest extant in the country and the only remaining at the Fairmount Water Works.
[52] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 8.
[53] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 90.
[54] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13.

towers on the west side of the Schuylkill River,[55] in horizontal cross-section it consisted of five wrought iron Phoenix columns arranged in a square (one column in each corner and one in the center) surrounded by eight wrought iron Phoenix columns arranged in a larger square and all braced with wrought iron rods. Two 40-person-capacity elevators, powered by a 15-horsepower duplex steam engine, carried visitors to and from the top.

When it opened in June 1876[56] it was an immediate hit, inducing visitors to the centennial celebration to take the ten-cent ride across the river on one of the steamboats that carried passengers to various points around the Fairmount Pool. The view from the observation deck was a rarity at the time. As one looked down upon the Fairmount Water Works and Fairmount Reservoir, the Schuylkill River meandered into the distance in opposite directions, the Centennial grounds could be seen across the river, and the city stretched to the horizon all around. In clear weather, three states were visible. Enough people thought the 25¢ ticket (10¢ for children)[57] was worth the cost that even ten years later the tower was drawing an average of 2,500 visitors on summer Sundays and 500 on weekdays.[58]

The Lemon Hill Observatory influenced the number of visitors to the Fairmount Water Works. One Sunday in the summer of 1886, for example, 3,000 people rode the elevator to the top. The same day, a crowd numbering between 6,000 and 8,000 gathered to listen to a band playing in the pavilion in the North Garden, far exceeding the accommodation of the 350 park benches. Each attraction likely had an effect on the other. As an interesting aside, we tend to think that the youth of the past were more courteous than those of today, but perhaps not. A local

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[55] *New York Daily Graphic*, 18 Aug 1875; *Philadelphia Inquirer*, 17 Jun 1876. The two were the Centennial Observation Tower (sometimes called Sawyer's Observatory, located on the Belmont Plateau just to the north of the Belmont Mansion) and the George's Hill Tower. Both were situated just outside of the Centennial Exhibition grounds.
[56] *Philadelphia Inquirer* (Wednesday 28 Jun 1876), 8.
[57] *Philadelphia Inquirer* (Wednesday 28 Jun 1876), 8. The 2020 equivalent is $6.02 and $2.41 respectively.
[58] *The Times* [Philadelphia] (Monday 9 Aug 1886), 2.

newspaper reported, “The young people got the seats and the old people had to stand.”[59]

In 1878 an incident occurred at the tower which was reported as far away as San Francisco. During a day of large attendance, approximately 300 people had crowded onto the observation deck. In an attempt to handle the throng, the elevator operator squeezed 52 people into a downward-headed elevator car, causing an overweight condition. One of the overstressed cable guide pulleys broke and the car jammed 150 feet in the air. The displaced car caused the cable on the other elevator to slip and jam, causing that car to become stuck 20 feet off the ground on the way up. After much shouting by those in the higher car, Park Guards were able to restore both elevators to operability and bring the occupants of both cars safely to the ground about 45 minutes later.[60]

Despite the attraction’s popularity, it was closed in 1896 due to safety concerns. Two years later the Fairmount Park Commission called for its demolition. Stockholders of the Philadelphia Observatory Company hired mechanical engineer Thomas Shaw, who along with inspectors from the City’s Bureau of Building Inspectors spent several days in July examining the structure. After a few minor repairs, the tower was declared safe and by late August reopened to the public. In 1899, however, it was again declared unsafe. It was sold at auction for $1,025[61] to scrap dealer C. R. Baird & Co. on 6 Jun and demolished on 21 Aug.[62]

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[59] *The Times* [Philadelphia] (Monday 9 Aug 1886), 2.

[60] *San Francisco Examiner* (Wednesday 17 Jul 1878), 1; *Cincinnati Enquirer* (Monday 8 Jul 1878), 7; *Selinsgrove Times-Tribune* (Wednesday 7 Aug 1878), 4.

[61] The equivalent of less than $33,000 in 2022.

[62] *The Times* (Philadelphia) (Monday 9 Aug 1886), 2; *The Times* [Philadelphia] (Saturday 14 May 1898), 7; *The Times* [Philadelphia] (Sunday 31 Jul 1898), 6; *Philadelphia Inquirer* (Saturday 27 Aug 1898), 11; *Philadelphia Inquirer* (Wednesday 7 Jun 1899), 7; *Reading Eagle* (Thursday 8 Jun 1899), 4; *Philadelphia Inquirer* (Sun 15 Oct 1899), 3; *Philadelphia Inquirer* (24 Mar 1915).

William Ludlow was elected Chief Engineer by City Councils and took office on 12 Mar 1883.[63] Born in Islip on Long Island, New York, he had a long and distinguished career as an officer in the U.S. Army Corps of Engineers, retiring as a Major General. While still in the military he served as Chief Engineer of the Water Department for three years. He did so while on leave from the Army and without drawing a salary from the City of Philadelphia.[64]

Ludlow was brought in on a wave of reform that had penetrated City Councils.[65] In the preceding years, City agencies had increasingly become a jobs bank for the well-connected. As Councils had progressively reclaimed powers given to the mayor and executive branch under the Consolidation Act of 1854, Council members—and the ward leaders who had a strong hand in electing them—increased their control over City jobs. There was a lot of money for the taking. In 1879, for example, municipal jobs numbered over 4,000, with total annual salaries worth over $2.5 million.[66] The party in Councils that could get its man elected to head an agency controlled the jobs in that organization.[67]

The practice of hiring political cronies as a means of reward became so ingrained and widespread, in fact, that under McFadden, Ludlow's predecessor, the Water Department maintained an official record of such patronage.[68] Ludlow described what he found upon his arrival:

> The situation in 1883 was such as no community could afford to maintain, and unless

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[63] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 1.
[64] "William Ludlow—Major General, United States Army," *Arlington National Cemetery* (7 Jul 2022), <http://www.arlingtoncemetery.net/wludlow.htm>, accessed 23 Sep 2022.
[65] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 144.
[66] The equivalent of approximately $75 million in 2022.
[67] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 39, 211n.73.
[68] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 39, 211n.74.

> remedied could only culminate in disaster. The Department had for years been run as a political machine in the interest of individuals, and made the harboring-place of henchmen who were quartered upon the City by the score and maintained at the public expense, although in many cases their services were entirely valueless, and in all cases political service and work of some sort were demanded as the price of appointment and retention.[69]

Ludlow went on to characterize the Water Department at that time as "honey-combed with intrigue and inefficiency, destitute of discipline or recognition of authority, [with] disorder and waste prevailing."[70] Ludlow, however, had a reputation for being the straightest of straight arrows. His response to a later bribery attempt was characteristic:

> "That's a cool fellow," said an up-town manufacturer pointing across Chestnut Street, where Colonel Ludlow, the Chief of the Water Department of Philadelphia, was waiting for a [trolley] car. "Let me tell you something which happened a few days ago to a friend of mine, whose large establishment consumes a great deal of water, and who has frequent favors to ask of the Water Department.
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> "He recently visited the Chief's office, and found Colonel Ludlow, as usual, very polite. My friend, before proffering all of his requests, took a $50 bank bill[71] from his pocket and passed it over to the Chief, who examined it curiously for a second and then spread it upon the desk before him.
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> "[Colonel Ludlow] did not utter a word at the moment, but when his visitor [had finished his requests and] was about to go away, said: 'Now, my dear sir, what is this for?' holding up the bill. 'Oh! that's to buy cigars for the boys,' was the careless reply. 'Yes,' said Ludlow, 'then I suppose that you are fond of the weed yourself?' My friend said that he enjoyed

[69] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 143.
[70] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 143.
[71] In 1886, the year Ludlow left the Water Department, a fifty dollar bill had the value of approximately $1,575 million in 2022.

nothing better than a good cigar. 'Then allow me,' said the Colonel, suavely, 'to insist upon your trying one of these,' moving to a secretary and taking down a box of Henry Clay Specials.[72]

"Each gentleman took a cigar and bit off the end. Then with a careless gesture Colonel Ludlow rolled up the $50 bill into a paper-lighter, reached up to the gas, allowed it to become thoroughly ignited, and slowly lit his own cigar. … This done, the Colonel turned with an easy and polite motion, and said: 'Permit me,' and held the blazing bill under the nose and up to the cigar of my amazed and startled friend, whose eyes had now become almost as big as dinner plates. With two or three gasping inhalations he managed to get a light. He kept his eyes upon the bill until it burned to the very fingers which held it. Colonel Ludlow watched its last expiring spark as he idly allowed the smoke of his cigar to escape from between his lips.

"When the bank note had been completely reduced to ashes the Colonel turned to his visitor and said carelessly: 'How do you like your cigar?' The gentleman admitted its excellence and took his departure, attended to the door by the Chief, who with the utmost courtesy shook him by the hand, and then closed the door to resume his work at his desk.

"My friend gets purple in the face every time he thinks of the affair, and confided it to me simply to warn me how to behave myself at the Water Department."[73]

Ludlow maintained that the function of the Department was so vital to the well-being of the city that it was dangerous to allow it to remain a haven for political hacks who had no expertise and did nothing but collect a paycheck. "Politics," Ludlow declared, "had truly brought

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[72] A popular brand of Cuban cigar, created in the 1840s by Spanish émigré Julián Álvarez Granda. The cigar is still manufactured today, in El Salvador, by the Altadis USA division of the British multinational tobacco company Imperial Brands plc. See "Henry Clay," *Altadis USA* (2020), <https://www.altadisusa.com/cigars/henry-clay>, accessed 13 Jun 2020.

[73] *Engineering News and American Contract Journal*, Vol. XI, Jan–Jul 1884 (New York: Engineering News Publishing Co., 7 Jun 1887), 291; "Historical Vignette 024—The Bribe that Went Up in Smoke," *U.S. Army Corps of Engineers* (May 2001), <https://www.usace.army.mil/About/History/Historical-Vignettes/Civil-Engineering/024-Up-in-Smoke/>, accessed 1 Mar 2020.

the service into a perilous condition, and the Chief Engineer [was] harassed by his responsibilities but unable to shake off the bondage that paralyzed his usefulness."[74]

The new Chief Engineer had no intention of remaining paralyzed, however. Accepting the position "upon the distinct condition that no personal or political consideration should influence my judgment or control my action,"[75] Ludlow immediately did two things. First, he conducted a thorough, top-to-bottom evaluation of the entire Department, including its organization, its policies and procedures, the condition of its physical plant, and future needs. Second, he assessed the amount of funds available for repairing the existing system and increasing its capacity.[76]

Ludlow discovered a Department in disarray. Organizations often suffer from having too many managers and not enough workers. In this case Ludlow found it the other way around. Patronage[77] had fattened the employment rolls so that at many facilities there were more employees than work do be done. Worse, political hiring had destroyed discipline. Workers were allowed to come and go whenever they felt like it. Many worked as they pleased, when they pleased, and supervisors found they were unable to do anything about it. There was a general lack of accountability at all levels.[78]

Basic security was poor. At the Spring Garden Works, tramps were allowed to sleep unsupervised in the boiler rooms where it was warm, as long as they fed the boilers with coal while the paid employees left the premises. At the Kensington Works,[79] outsiders loitered regularly, neighborhood youths were allowed to run around and cause mischief, and fishermen

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[74] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 143.
[75] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 143.
[76] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 8.
[77] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 27.
[78] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 26.
[79] The Delaware Works was known as the Kensington Works from 1883 until its abandonment in 1890.

dried and mended their nets on the property.[80]

The machinery suffered. Steam engine boilers, for example, weren't cleaned or fired correctly and repairs were put off. This led to excess coal consumption, reduced pumping performance, and increased frequency of breakdowns. Record-keeping was undependable. At some stations the machinery was rigged to register inflated pumpage figures. In at least one station, the pumpage counters were regularly manipulated by hand to display artificially high numbers.[81]

In 1883 Ludlow reorganized the Department, creating a complete set of well-defined job descriptions and a clear chain of command (specifying who was responsible to whom). He communicated to all employees that the effectiveness of the Department was the "first consideration."[82]

Ludlow ignored patronage requests and implemented a system of merit-based hiring, with a standardized application process independent of political considerations.[83] Performance-based evaluation of employees was begun. At each facility he gave the superintendent full authority and then held him accountable to his responsibilities. Ludlow did this up and down the chain of command. Each employee's retention henceforth depended upon "the need of his services, his qualifications for the position occupied, and the faithful and satisfactory discharge of his duties."[84] If an employee couldn't meet the demands of their job, they were removed. No one would be fired, however, nor even have their job description changed, without due cause.[85]

"It is by such means as these," Ludlow asserted, "that a service such as that of the Water

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[80] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 26.
[81] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 26.
[82] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 29.
[83] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 71f.
[84] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 29.
[85] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 25f, 29, 71f.

Department can be maintained in fit or even respectable condition. To the extent to which it is used for so-called political purposes it is corrupted and demoralized."[86] Ludlow believed that for the Department to be successful, this standard must be demonstrated at the top.

> While there is a large amount of technical work required, the most important duties of the head of the Department are administrative, and unless he can keep himself aloof from political entanglements and control, his usefulness must be seriously impaired if not entirely destroyed. The principles above mentioned steadily adhered to, purified the service and rescued it from the slavery that owns a master and dreads nothing so much as the withdrawal of his favor.[87]

Predictably, this heightened accountability was resisted. At Spring Garden, where there was perhaps the largest number of workers who had been hired for political considerations, "some who supposed themselves possessed of 'influence,'" as Ludlow put it, staged a work stoppage. On the Fourth of July, when they thought it would be difficult to hire replacements, most of the workers shut down the machinery and walked off the job. They hadn't reckoned on the reservoirs being full, however. This bought the Department some time and by the next morning Ludlow had hired new employees to work the boilers and engines. When some of the rank and file found themselves permanently out of work, they claimed that they had been misled by the patronage hacks among them and pleaded for their jobs back.[88]

A Department-wide review of the salaried roll revealed thirty unnecessary employees; their elimination saved over $18,000 annually.[89] Ludlow reported, "There was no further trouble in this direction."[90]

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[86] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 143.
[87] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 144.
[88] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 27.
[89] The equivalent of approximately $527,800 in 2022.
[90] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 27.

In order to prevent needless spending, Ludlow created a new requisition system. All expense requests had to be justified and were submitted up the chain of command, with approval required at each supervisory level. Ludlow personally reviewed and approved or rejected each one. Every request was recorded and tracked from submission and approval to delivery and payment.[91]

The weighing scales at many of the stations had been out of order for many years, so that bulk deliveries could not be checked for accuracy. This opened the door for contractor fraud and resulted in the estimation of coal consumption instead of actual measurement. Ludlow promptly had the scales fixed.[92] In a further attempt to save money, he ordered a test to determine the most economical size of the coal used to fire the boilers of the Department's steam engines.[93] When it was determined that pea coal produced the most energy, dollar for dollar, he directed all coal purchases to be changed to that size. The resulting decrease in coal consumption saved at least $25,000 per year,[94] a 20 percent reduction in the annual coal budget.[95]

Ludlow found the Department telegraph inoperative more often than not. In 1883 he replaced it with a telephone system.[96] It was a closed system, with only the central switchboard connected with the outside world, but an operator was on duty round the clock. All of the reservoirs were connected with their pumping stations, and all stations and administrative offices were connected to the main office and with each other. The watchman at each reservoir was

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[91] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 28.
[92] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 28.
[93] The standardized sizes of lump coal are barley (like coarse sand), rice (the size of a pencil eraser), buckwheat (dime-size), pea (quarter-size), nut (golf ball-size), stove (baseball-size), and egg (softball-size). They are all technically described by minimum and maximum dimensions, but the *Coalpail Coal Forum* provides for the layman these rather more helpful descriptors on its website. See "Anthracite Coal Sizes," *Coalpail Coal Forum* (2017), <https://coalpail.com/coal-heating-encyclopedia/anthracite-coal-sizes>, accessed 13 Jun 2020.
[94] The equivalent of approximately $733,100 in 2022.
[95] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 16f.
[96] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 17f.

required to report their status to their pumping station at half-hour intervals; previously they had to leave their post in order to report. The pumping stations in turn reported to the main office every hour.[97]

Engines could now be stopped or started, valves closed or opened, as needed, "without loss of time." This had obvious advantages in the case of fire, for example, when engines could be quickly run up and valves changed in order to increase water pressure in a particular area.[98]

Ludlow simultaneously worked a seemingly endless list of repairs and improvements to the physical plant. Defective and dangerous engines and boilers were renewed. Intakes were cleaned and suction wells were cleared of debris that had been clogging the pumps. He also saw to it that facilities were cleaned and renewed. Deferred mechanical maintenance and dilapidated workplaces, Ludlow recognized, not only impaired efficiency in the short term and increased costs in the long term but it destroyed morale and human performance. "The more complete the arrangements for the comfort and convenience of the men, the better work will they do."[99]

This was not only a good investment, Ludlow asserted, it was a public responsibility.

> The management of the public works of a city…requires that it should be in no respect inferior, and, if possible, exhibit a better system and efficiency than that of private establishments, both because the people who defray the cost of the service are entitled to an economical use of the public funds, which are heavily drawn upon for many other purposes, and because the city works are open to examination, and subject to public approval or condemnation.[100]

At Fairmount, Ludlow described a station in want of upkeep. The buildings were

[97] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 18, 28f.
[98] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 18.
[99] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 9. Today this is often expressed as, "Take good care of your employees and they will take good care of you."
[100] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 9.

suffering from a lack of basic maintenance. The roofs of the Old and New Mill Houses leaked so much rain and silt that the machinery looked like it had recently been flooded. The turbines were performing at less than half their expected efficiency. Many of the head gates were so corroded they were frozen open. The floor joists and supports were rotting. Everything was filthy, down to the public rest rooms.[101]

Although Ludlow acknowledged the station was no longer the most important in the system[102] and knew that it was even less so during dry seasons,[103] he poured a great deal of effort into renewing the machinery. In 1883 only minor repairs were made to the turbines,[104] but between 1884 and 1885 he gave all of the turbines and pumps a complete overhaul. Many of the main shafts, bearings, wheel blades, wood teeth for spur and bevel wheels, crank pins, valves and valve seats, various fasteners, and virtually all brass fittings were replaced. Others were repaired. Loose flywheels were tightened. New tail gates were fabricated and hung. Pump cylinders were re-bored and new plungers fitted. Spare parts were fabricated.[105] Head gates were replaced.[106] It was a thorough-going tune-up.

The wood gate across the north side of the Forebay Bridge was rotted and inoperable. Its raising mechanism was rusted and immovable. In 1883 the entire structure was replaced with a temporary wood bulkhead. The wood gates at the head of the intake flumes for defunct Wheels 2 and 6 (original breast wheels 1 and 8) were removed, their single archways were altered to double archways, and new wrought iron gates with gun metal facings were installed. This work,

[101] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10, 97f.
[102] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 13.
[103] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10.
[104] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 99.
[105] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 12; Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 158.
[106] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10.

requiring the construction of cofferdams, was begun in 1883 and completed in 1884.[107]

The new gates at the head of the flumes of Wheels 2 and 6 allowed workers to periodically run water through the empty bays. It was hoped this would create a strong enough current through the Forebay to scour silt deposits which were apt to build up during dry periods when the Schuylkill River was low and the turbines were run less often. To ensure that this did not waste precious water power, it was done only when there was plenty, as indicated by water overflowing Fairmount Dam.[108]

Before the scour method could work effectively, accumulated silt needed to be cleaned from the Forebay. In 1884, with the temporary bulkhead in place across the upstream side of the Forebay Bridge, the Forebay was completely drained. Approximately 2,000 cubic yards of mud was cleared and the abandoned wrought iron discharge mains from the breast wheels were exposed. Left in place at the bottom of the Forebay when the Old Mill House transitioned to turbines, the old mains were finally hauled up and carted away. When this was completed, the temporary bulkhead on the north side of the Forebay Bridge was removed and the arches left open.[109]

During this time, the Fairmount Reservoir served the area of what is today known as Center City—form Vine Street to South Street, between the Delaware and Schuylkill Rivers. On 4 Sep 1884 an incident occurred which demonstrated just how slim the water supply's margin of safety was in at least this area of the city.[110] At 26th and Callowhill Streets, a valve stop on the 20-inch main leading from the Fairmount Reservoir to the south malfunctioned. As workers tried

[107] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 97; Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 158.
[108] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 97.
[109] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 158.
[110] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 27ff, 191.

to adjust the valve, it broke completely and the pressure shot part of it high into the air. Between the flying pieces and the resulting high-pressure fountain, the workers retreated for their own safety. In order to prevent the reservoir from emptying, the workers next moved upstream and tried to close a valve on the retaining wall, but it jammed open and attempts to force it closed merely broke it in the open position.

Repairs to neither valve stop could be made while they were under pressure, so the only recourse was to drain the reservoir. All pumping at Fairmount was halted and the reservoir was completely drained as rapidly as possible. While repairs were under way, water for Fairmount's district was drawn from the Corinthian Avenue Reservoir. Although it had its own area to supply, it was able to temporarily supply Fairmount's as well.

As the situation was normalized, new complaints of low water pressure were heard from residents and businesses in the Center City area. A search for the cause was immediately initiated, but it took two and a half days to pinpoint the source. At long last, a general sampling of pressure readings indicated the lowest pressure was along 8th Street above Arch. Upon visiting the area, workers immediately heard the sound of rushing water from within a sewer inlet. A closer inspection revealed that where the 10-inch main passed close to the inlet, an estimated 32- to 45-square-inch portion of the pipe had blown out. Water was gushing out through the hole and into the sewer. Two valves, one on either side of the break, were closed within fifteen minutes of its discovery and pressure was quickly restored.

Ludlow remarked with amazement that nearby residents had sent a flurry of complaint letters while the roar of water was clearly audible to them. If even one person would have thought to mention that, he noted, the trouble could have been fixed within hours or even minutes instead of days.

More importantly, the fact that this one break had caused a 50 percent reduction in pressure over a wide area underscored just how easily such a large part of the supply could be lost. Ludlow pointed out that a serious fire at the same time might have been devastating. The situation also called attention to the degree to which the supply was reduced by waste, "which probably is constantly doing what the break in the Eighth street [*sic*] main did for two days."[111]

The problem with two of the valves at Fairmount was a troubling indication of the condition of the infrastructure there.[112] While the reservoir was empty during the repair of the two broken valves, Ludlow took advantage of the opportunity to inspect all of the basins, including the inner slopes, inlets, and partition gate valves. The deterioration was worse than expected; he found "every part…in a wretched condition."[113] Some portions of the basin partitions, for example, had been constructed of wood and had rotted away. Ludlow recommended reconstructing the partitions in stone.[114] The brick lining of the western embankment was repaired and the interior slope was cleared of brush.[115] Later the brick lining of Basin 3 was repaired; angle iron was installed to keep the bricks in place. The outlet house was rebuilt and wood frames for the screens were fabricated.[116]

The draining of the Fairmount Reservoir also graphically revealed just how much sediment had built up within it.[117] The next year Ludlow gave it a thorough cleansing[118] while

[111] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 28.
[112] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 28f.
[113] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 191f.
[114] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 192.
[115] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 191.
[116] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.
[117] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 28.
[118] With 11 years since the last cleaning, this represented an improvement in frequency. The first cleaning was accomplished in 1851–52, 31 years after the oldest basin first received water. The next took place in 1874, 22 years after the first, with the 1885 cleaning occurring 11 years later. See Watering Committee, *1851 Annual Report* (1 Jan 1852), 5f.; Watering Committee, *1852 Annual Report* (6 Jan 1853), table at 48; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 13.

employing some creative engineering.[119] Ordinarily, water pumped from the Old Mill House was discharged into Basin 2, the westernmost. Using a derrick, a wood conduit was built across Basin 2 so that the water was discharged instead into Basins 1 and 3 (farther to the east) to keep them partially filled. The remaining basins were drained into the distribution system. Using the water from Basins 1 and 3, the mud remaining in the emptied basins was first "washed and shoveled" into Basin 4C through a break in the dividing partition. A steam-driven centrifugal pump, mounted on a platform specially built on the embankment of the basin, then forced the mud into Basin 2. From there the mud flowed out and down the ascending and discharge main through the pump of Turbine 1, whose valves had been removed for the purpose, and into the river below the dam.

At about this same time, the valves were also removed from the pumps of Turbine 7, wood plugs were placed between the pumps and the flume, and the pumps were disconnected in anticipation of cleaning the Corinthian Avenue Reservoir in a similar fashion. This wasn't done, however; the valves were replaced, the plugs removed, the pumps reconnected, and the turbine was returned to operability.[120]

In the Old Mill House, Wheel 2 (original breast wheel 1), derelict and unused for years, was removed along with its pump in 1884. Ludlow thought installing a small turbine in the space was a good idea but believed other considerations were far more pressing.[121] The surface upon which the pump had been mounted was smoothed and leveled with a granolithic material.[122] The

[119] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203, 204.
[120] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 205. The plugs are called "bonnets" in the Annual Report. The report does not specify how the pumps for either turbine were disconnected, nor does it describe how the mud flowed from the pumps to the river.
[121] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 13.
[122] Still a commonly used material, granolithic is a type of concrete composed of fine aggregate, sand, and cement. Usually laid atop a solid base, it is sometimes used when a tough wearing surface is required but it is desired to have a smoother finish than can be achieved with ordinary concrete. See, for example, "Granolithic Screed: When to Use

openings in the sidewalls where the shaft of the breast wheel had been mounted were bricked up.[123]

A year later, following up on his promise to look after the workers' "comfort and convenience," Ludlow had a dressing room for oilers constructed in the Old Mill House in the empty space beneath the old Watering Committee Building. This was once the bay for Wheel 6 (formerly breast wheel 8), which had been removed in 1874 and not replaced. A new floor was laid, supported by new wood joists which replaced the old wood which had been completely scoured away by the action of flowing water. A new doorway was cut, the walls were plastered, and woodwork was installed and painted. A ventilator was built into the ceiling and ductwork from it was carried up through the Watering Committee Building and to its roof.[124]

The hot water heater installed in the New Mill House by Cassin in 1864 was no longer working well. In 1883 Ludlow replaced it temporarily with a small steam boiler from an old hoisting engine in the Department's inventory.[125] In 1885 he repaired the steam heating system in the Old Mill House, originally installed by Graff, Jr. in 1872, and extended it to the New Mill House, replacing the temporary setup he had installed there two years earlier.[126] For safety he installed a two-inch fire hose, connected to the discharge main of Turbine 3.[127]

To make it easier to operate and maintain the turbines, pumps, and ancillary machinery, Ludlow rebuilt or repaired the work platforms, steps, and trap doors. He laid new concrete floors throughout both the Old and New Mill Houses. A blind, or concealed, door was installed in the

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It, and How to Choose It," *Rockland Flooring* (last updated 12 Aug 2015), <http://www.rocland.eu/en/granolithic-screed-when-to-use-it-and-how-to-choose-it>, accessed 8 Jun 2020.
[123] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 98.
[124] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.
[125] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 98f.
[126] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.
[127] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 204.

Turbine 1 area.[128] He installed a new floor in the carpenter shop.[129]

The cast iron columns in the New Mill House and the wrought iron Phoenix columns in the Old Mill House, as well as the wrought iron I-beams in the roofs of both, were scraped and repainted. The interior walls of both buildings were given two coats of whitewash. Even the vaults and cellars were whitewashed.[130] The public viewing galleries were repaired and renewed.[131] In the Old Mill House the doors to the river-facing balconies were replaced.[132]

In 1883 the public rest rooms were found to be “in a filthy condition.”[133] That year Ludlow had the men’s room gutted and rebuilt with new fixtures and plumbing. The same was done with the ladies’ room the following year. The rest rooms were kept open from the first of May to the first of November, from ten o’clock in the morning until eight o’clock in the evening. A janitor was assigned to keep them clean.[134]

The Pavilion and the Eagle Pavilion were repainted, as were the balustrades and the mains across the Forebay.[135] The woodwork on the exterior of the Standpipe was repaired and the entire structure was repainted.[136]

The boiler left over from the auxiliary Worthington steam engine[137] was removed in 1883 from the ornamental building on the north side of the Forebay. The building was repaired, repainted, and refurbished so that it could be used as a carpenter’s shop.[138] The following year,

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[128] The precise location of the blind door is unclear.
[129] Water Department, *Chief Engineer’s 1885 Annual Report* (1 Apr 1886), 203.
[130] Water Department, *Chief Engineer’s 1884 Annual Report* (1 Apr 1885), 159.
[131] Water Department, *Chief Engineer’s 1884 Annual Report* (1 Apr 1885), 159.
[132] Water Department, *Chief Engineer’s 1885 Annual Report* (1 Apr 1886), 203.
[133] Water Department, *Chief Engineer’s 1883 Annual Report* (Apr 1884), 97.
[134] Water Department, *Chief Engineer’s 1884 Annual Report* (1 Apr 1885), 159; Water Department, *Chief Engineer’s 1885 Annual Report* (1 Apr 1886), 203.
[135] Water Department, *Chief Engineer’s 1883 Annual Report* (Apr 1884), 97.
[136] Water Department, *Chief Engineer’s 1884 Annual Report* (1 Apr 1885), 159.
[137] Recall that the engine was moved to the Frankford Station in 1878.
[138] Water Department, *Chief Engineer’s 1883 Annual Report* (Apr 1884), 98.

however, it was instead converted to a facility to test and fit water meters and a carpenter's shop was set up in the Watering Committee Building.[139] While the meter shop was being completed, the coal sheds associated with the steam engine's boiler ("so long a disgrace to that part of the Park," in Ludlow's words) were removed. The area where they were located, near the Forebay, was cleared of debris, leveled, and sodded.[140]

In 1884 the river wall beneath the front of the Engine House and along the Esplanade was refaced with hydraulic concrete.[141] Over three years the Engine House itself "received a thorough overhauling." The roof was repaired. Walls were re-plastered, painted, and papered. Flooring was replaced, woodwork was repainted, and window sashes were repaired. The office was refitted.

The Rustic Pavilion, overlooking the South Garden and completed in 1867, had become unsafe and was torn down in 1883.[142] In 1885 the flagstones at the south entrance to the South Garden were reset. The balustrade along the top of the South Garden's river wall was repaired and the one along the Forebay was repainted. The stonework surrounding the spring on the north side of the reservoir was repaired. Foundations were constructed for two sphinxes to be set atop

[139] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 159.
[140] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 158. Ludlow called the sheds "long a disgrace to that part of the Park." The reason they survived as long as they did is unclear. Perhaps they were used to store coal for the coal stoves used for heat in the Old Mill House until 1872. Perhaps they were used to store grounds maintenance equipment.
[141] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 159.
[142] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 122. From the report: "The Swiss *chalet*, overhanging the rock on the west side of the reservoir, was in a dangerous condition and has been removed." (Italics original.) Of the four "summer-houses" built in 1866–67, the Rustic Pavilion was the only one that could be described as a Swiss chalet. Constructed only sixteen years earlier, it had apparently suffered from neglect. Subsequent annual reports present conflicting information regarding the remaining three. The report for 1886 says that they were all demolished that year, while the report for 1887 says that one of them was repainted and received a new roof and rain gutters. The report for 1889 does not specify the number remaining, but says they continued to be "kept in repair," however many there were. Available photographic evidence is inconclusive. See Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85; Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115; Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.

the cliff-face between the North and Central Cliffside Paths. The original wood *Allegory of the Schuylkill River* was repainted and placed on a new base in her old place behind the Forebay.[143]

Ludlow recommended the grounds be lit with electric lights and that arc lights be installed around the reservoir. He said this would not only be beneficial to the thousands of visitors on hot summer nights but would "enable the Department police to preserve better order."[144] This recommendation was not implemented.

McFadden, Ludlow's predecessor, had complained for years that the deck roofs of the New and Old Mill Houses leaked and made maintenance of the machinery difficult. In an attempt to correct this,[145] Ludlow in 1883 replaced the asphalt surface on the deck of the New Mill House with one composed of granolithic. On the deck of the Old Mill House and the deck on the river side of the Engine House, however, he covered the brick pavement with Neufchatel, a material similar to what he removed from the New Mill House.[146]

In 1885 Ludlow embarked on an experiment at the Belmont Works designed to evaluate a process to reduce the effects of pollution on the water supply. Compressed air was injected into the discharge mains leading from the pumping station to the George's Hill Reservoir. The amount of air was 20 percent by volume. The experiment had a positive effect almost immediately. Compared with the water at the intake, the water discharged into the reservoir had 40 percent less albuminoid ammonia, 76 percent less free ammonia, and a complete elimination

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[143] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.
[144] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 192.
[145] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 97; Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10.
[146] Neufchatel was a name sometimes used for asphalt or bitumen, after the town in France where there is a naturally occurring surface formation nearby. The reason for replacing the asphalt surface on New Mill House roof and laying asphalt on the Old Mill House roof is not specified in the Annual Report. Whatever the reason, it was not entirely successful. By 1888, Ludlow's successor was again complaining that the roof "leaks badly." See Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 141; Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 142.

of nitrous acid, three common measures of polluted water at the time. Within a year, albuminoid ammonia had been reduced by 50 percent and free ammonia had been reduced to near zero.

The dissolved air apparently stayed in solution for some time. It was reported that a glass of water appeared “as white as milk for a minute or two” after being drawn and that this was the cause of apprehension among some residents until it was explained to them.

The experiment was successful enough that Ludlow planned to deploy the process to other pumping stations. At Fairmount, for example, one end of one of the pump cylinders for Turbine 8, in the New Mill House, was modified to drive a compressed air pump.[147]

After about a year of operation, however, one drawback became so great that the idea of introducing the process elsewhere was ultimately abandoned. It turned out that forcing air into the discharge mains caused them to leak terribly at their joints. Oddly enough, whenever the air injection was stopped, the leaking stopped. A solution to the problem was never found. It was feared that a wide-scale expansion of the practice might cause a particular weak or poorly laid main to fail and “possibly cause disaster.” Ludlow’s successor made the decision to avoid the risk of damage to machinery and other infrastructure; the experiment was never deployed beyond the Belmont Station.[148]

One of the results of the lax accountability over the years was the creeping unreliability of the records of the Registrar’s Office. With certain exceptions, water bills, or water “rents” as they were called, were based not on actual consumption but on the number and types of “water appliances” that each customer had on their property—fixtures such as spigots, kitchen sinks, toilets, and the like. Accurate billing depended upon accurate records.

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[147] Water Department, *Chief Engineer’s 1884 Annual Report* (1 Apr 1885), 160.
[148] Water Department, *Chief Engineer’s 1885 Annual Report* (1 Apr 1886), 49; Water Department, *Chief Engineer’s 1886 Annual Report* (1 Feb 1887), 12f.

Customers were allowed to self-report. In order to prevent fraud, the system relied on the integrity and attentiveness of the Registrar's inspectors. Even when honestly reported by customers, if inspectors were not diligent in updating the master records, eventually they would be virtually useless. When Ludlow became Chief Engineer in early 1883, he suspected this had become the case.

As a test, Ludlow decided to examine bars and horse troughs because they were particularly hard to ignore. The assessment revealed, however, that ignoring many of them was exactly what the inspectors were doing. In some districts they had been undercounting them by the score. In one district over a hundred had been overlooked. The initial assessment had determined that the records were indeed unmoored from reality.

Ludlow directed a general re-inspection. It was a massive task, requiring a block-by-block, property-by-property dissection of the entire city. No less formidable was the deadline he imposed: have it all finished by the first of February 1884, in time to send out accurate bills for the year. The main inspection got under way in August 1883. In all, over 160,000 properties were examined. Ludlow reassigned employees to help and hired six additional workers to serve as temporary inspectors, bringing the total number to twenty, including their chief. In the end the project was accomplished on time.

As expected, there were a large number of corrections. In some cases, the record was corrected downward. Usually, however, and despite "frequent attempts…to bribe the inspectors," it was the other way around. Ludlow reported that although the re-inspection cost $10,353,[149] he expected the more accurate billing to net the Department an increase in revenue of $225,000 per

[149] The equivalent of approximately $312,900 in 2022.

year.[150]

All that Ludlow managed to accomplish he did in only three years. By 1886 the machine was ascendant in Councils again and it was "fully explained" to him that he could no longer keep the Water Department from becoming a political plaything.[151] When he realized that he would only be allowed to continue as Chief Engineer if he compromised his integrity and participated in the corrupt deal-making that surrounded him, Ludlow resigned from the position.[152]

Although looking back he expressed his satisfaction at what he was able to achieve, he also said:

> I recognize too that much that has been done might have been better done could I have brought to its service a close preliminary acquaintance with the needs and condition of a business of such magnitude and complexity. …and I cannot avoid expression of recognition of the almost uniform consideration by which my work has been supported and encouraged in every quarter of any value, and which I am gratified to say has endured to the end.[153]

In other words, and in typical fashion for him, Ludlow took the blame for any failure and gave all of the credit for any success to the team. Today this is universally recognized as one of the cornerstone practices of good leadership.

Although he was pleased that his successor, John L. Ogden, was someone of good character,[154] Ludlow sounded a pessimistic note on his departure:

> This broad departure from the common acceptation of city office and employment will

[150] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), ix, 27f, 29ff. The amount is the equivalent of approximately $6.8 million in 2022. Since Philadelphia's population in 1880 was 847,170, this figure represents nearly $7.00 (the equivalent of approximately $211 in 2022) per person. See "Population of the 100 Largest Urban Places: 1880," *U.S Census Bureau,* last updated 15 Jun 1998, <https://www.census.gov/population/www/documentation/twps0027/tab11.txt>, accessed 9 Jun 2020.
[151] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 144.
[152] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 144.
[153] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 141, 142.
[154] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 144.

> find no favor with those who, by the contrary view, use it for selfish purposes and are enabled to maintain themselves in power through an army of adherents whose service is paid primarily to their patrons, and secondarily, if at all, to the city which supports them. When it shall be clearly apprehended that this view of the public service is essentially servile and degrading, and inevitably fatal to economy and efficiency…, all branches of the public service of the city will be rendered honorable in the community, and be prepared to command the employment and retention of men of adequate attainments and character.[155]

At about the same time, the reassertion of machine politics was manifest in another way: the reorganization of the city's government. This restructuring, ironically, had its origin in a reform effort.

As with the Act of Consolidation in 1854, the reorganization required state legislation since, as was the norm in nineteenth century America, Philadelphia's municipal government was a creation of the state.[156] The legislation, called the Bullitt Bill, after one of its authors and principal sponsor, created a new City Charter; it was passed by the Pennsylvania state legislature on 1 Jun 1885 and took effect on 4 Apr 1887.[157] It aimed to curb municipal corruption in Philadelphia.

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[155] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 145f.

[156] Across the country at this time nearly all local municipalities operated on charters devised and granted by their state legislatures. In Pennsylvania it wasn't until 1951, after the Pennsylvania state constitution was amended in 1922 to allow it, that the City of Philadelphia began to operate under a home rule charter created and amendable by the City itself. Although somewhat less common today, 39 states still feature local municipalities defined by the so-called Dillon Rule, the principle that a municipality enjoys only that operating authority expressly and narrowly granted to it by the state government. See Jon D. Russell and Aaron Bostrom. "Federalism, Dillon Rule and Home Rule," *White Paper* (American City County Exchange, Jan 2016); "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16 (Harrisburg: Boyd Hamilton, 1854), 21ff; Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 627; "Philadelphia Home Rule Charter," *American Legal Publishing Corporation* (2020), <https://codelibrary.amlegal.com/codes/philadelphia/latest/philadelphia_pa/0-0-0-129479>, accessed 21 Mar 2020; and Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 42f.

[157] *Bullitt Bill, As Adopted By the Legislature of Pennsylvania, June 1, 1885.* (Philadelphia: Dunlap Printing Co., 1902). The bill was named after John C. Bullitt, one of the three prominent Philadelphians who drafted it. The other two were Dunbar Lockwood and Henry C. Lea. See Weigley, Russell F., ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Company, 1982), 497.

The charter streamlined bureaucracies by reducing the number of departments from 25 to nine and grouping within them the various former departments, now called bureaus. It gave more power to the mayor, including line-item veto of funding bills and the authority to appoint and remove department directors with only the advice and consent of City Councils. The bureau chiefs (formerly department chiefs) were no longer elected by Councils but appointed by their respective department directors through competitive and open review of candidates. The bureau chiefs reported to their department directors, who reported directly to the mayor.

The Water Department was renamed the Bureau of Water; it was grouped with the Bureaus of Gas, Highways, Surveys, and City Property in the Department of Public Works. The Chief of the Bureau of Water retained the title of Chief Engineer. He reported to the Director of the Department of Public Works who in turn reported directly to the Mayor.

Mayoral and other elections were now held on the first Tuesday in February and elected officials took office on the first of April. The mayor's term of office was increased from three years to four, with consecutive terms prohibited. His appointed department directors served for the mayor's term only, but bureau chiefs could be retained indefinitely.

Department directors were required to formally report on their bureaus to the mayor by the first Monday of each February; the mayor bundled these reports and added comments for a compulsory annual report to Councils regarding the finances and general condition of the affairs of the city.

The Bullitt Bill may have been drafted by Philadelphians who intended it to stem corruption but its passage was shepherded in the state legislature by state boss Matthew S. Quay who recognized its potential to reduce interference from Philadelphia ringleaders like William S. Stokley and James McManes. Instead of reducing corruption, as the reformers had hoped, it had

quite the opposite effect. By investing so much authority in the mayor and providing for virtually no enforcement of its anti-patronage provisions, the Bullitt Bill and the associated enabling legislation produced by City Councils strengthened machine control of both the state of Pennsylvania and the City of Philadelphia by consolidating the alliance of rising new bosses in both locations—men like Quay and Boise Penrose in Harrisburg and "Iz" Durham, "Sunny Jim" McNichol, and the Vare brothers in Philadelphia—who made the early bosses look like amateurs by comparison.[158]

In February 1886, a little over a year prior to the implementation of the new city charter, John L. Ogden (1842–1903) was elected in joint session of City Councils to replace Ludlow.[159] Born and raised in Paschalville, a village in Kingsessing Township just west of Philadelphia which would become part of the City during the Consolidation in 1854, Ogden was first hired as a draftsman in 1866, during Birkinbine's second tenure. He had risen through the ranks of the Water Department, eventually being appointed Assistant Engineer for Distribution by McFadden in 1874 and General Superintendent of the Department by Ludlow in 1885.[160]

As with so many other chief engineers before him, Ogden's first action at Fairmount was to ensure the safety of Fairmount Dam. In 1886 he sank a crib of "heavy yellow pine timber filled with stone and earth" beside the upstream corner of the overflow side of the Pier, below the Eagle Pavilion. Projecting above the water line, the crib was a type of fender designed to protect

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[158] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 74f.

[159] *Journal of the Common Council of the City of Philadelphia,* 1 Oct 1885 to 1 Apr 1886 (1886), 307f. Ogden received a total of 93 votes (22 from Select Council members, 71 from Common Council members). Even after his resignation, Ludlow received a total of 20 votes (nine from Select Council members and eleven from Common Council members).

[160] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), ii; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 5; Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), v; "Obituary [John L. Ogden]," *Engineering News,* Vol. L, No. 18 (New York, 29 Oct 1903), 258.

the Pier from winter ice and other debris.[161]

In 1888 Ogden requested $10,000[162] to repair decayed sections of the cribbing on the downstream side of Fairmount Dam. When he didn't receive funding he optimistically programmed the work for the next year. The year 1889 was very wet, however, and high water levels in the Schuylkill River prevented the work from being accomplished. During a freshet, however, a portion of the lower structure broke away and was carried downriver. Surprisingly the structure wasn't destroyed; it was retrieved and the following year it was re-sunk and secured with over 24,000 square feet of crushed rock fill.[163] The entire dam received a thorough going-over, with rock fill and rotted timbers replaced.[164] During his time in office Ogden also replaced the flashboards along the comb of the dam multiple times.[165]

Ogden continued the aggressive maintenance of Fairmount's machinery pursued by his predecessor. In 1887, for example, every turbine saw work; some of it was fairly extensive. The blades in Turbine 1's static rotor were all replaced. The step upon which the bearing of the main shaft rested was repaired. The pump was re-bored and a new piston and rod were installed. The bearing journals for all of the wheels were tightened to remove so-called "lost motion. The floor of the flume was replaced. The other turbines received similar treatment the same year. Main shaft bearing steps were replaced, repaired, or adjusted, the alignment of bevel wheels was adjusted, and two pumps had their Cornish valves replaced with rubber valves.[166] To facilitate

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[161] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85. A similar structure may still be seen there today.
[162] The equivalent of approximately $311,800 in 2022.
[163] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1881), 141; Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 147. "About 1000 perch of stone" was used.
[164] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 79.
[165] For example, Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85; Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114; Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166; Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[166] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115f.

maintenance, a new boat was built for worker access to the river side of the turbines.[167]

The next year the lignum vitae bearing in Turbine 4 was replaced with an oil-lubricated glass bearing designed by Emile Geyelin. At 100 pounds per square inch, the bearing's surface received the 18½-ton weight of the moveable wheel, shaft, and attached bevel gear and allowed the assembly to rotate freely. The original bearing was situated below the water line, toward the bottom of the wheel pit, and was lubricated with water from a dedicated feed line which ran from the discharge main. If the feed line became clogged with silt the wood was liable to scorch, with resulting damage to the turbine. The modification to the turbine also relocated the glass bearing higher up inside the turbine where it was more easily inspected. The same type of bearing was installed in Turbine 3 two years later. Ogden recommended glass bearings be installed in all of the turbines.[168]

In 1888 additional pumps had their Cornish valves replaced with brass valve seats and rubber valves.[169] The wood teeth on some of the bevel wheels were replaced, and the connections to their shafts were tightened.[170] The Old Mill House discharge mains over the Forebay were repainted.[171]

The next year more Cornish valves were replaced with rubber. Pump pistons were also repacked.[172] Main shafts were removed and trued up, remaining lignum vitae main bearings were redressed, bevel gear teeth were renewed, and connections were tightened.[173] The wheel gate for

[167] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[168] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 126; Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 147, 169. All of the turbines were likely retrofitted with glass bearings. Although no Annual Reports explicitly state this, the Annual Report for 1902 indicates that Turbine 9 needed its glass bearing replaced at that time. See Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 116.
[169] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 126, 166.
[170] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166.
[171] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166.
[172] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 141, 171.
[173] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 171.

Turbine 1 was partially repaired with half-inch-thick wrought iron plate[174] and new tail gates were installed on all of the turbines.[175] Steam siphons, connected to the steam heating system, were installed in all of the turbine wheel shoes in order to blow water out of them after high tides.[176]

Ogden repaired the stop houses[177] and interior slopes[178] of the Fairmount Reservoir and removed silt which had accumulated in the outer Forebay.[179]

There was a tremendous amount of maintenance on the buildings during Ogden's watch.

A plastered and wainscoted men's room for workers was built in the Old Mill House.[180] A new janitor's workroom was constructed and all of the janitor's workspaces were repainted and re-varnished.[181] The police office and public ladies' rest room were repainted and re-varnished.[182] The flooring and joists in the engineers' office was replaced, the walls were repainted, the woodwork was re-varnished, and a stairway was constructed from the office to the Old Mill House.[183]

All of the heaters throughout the building complex were examined and repaired and the upright heating boiler for the Old and New Mill Houses was upgraded.[184] The interior walls in the New Mill House were re-plastered.[185] The iron roof girders in the Old and New Mill Houses

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[174] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[175] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 171.
[176] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 171.
[177] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[178] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166.
[179] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[180] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 84. According the Annual Report, the facility was "fitted up complete, plastered and wainscoted." Ludlow had done the same at other stations, for example, Spring Garden, but Fairmount had to wait until 1886. See Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 11.
[181] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114, 115.
[182] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[183] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114, 115.
[184] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 116. This was likely a holdover from Ludlow's plans for "workers' comforts."
[185] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114f.

and the frame of the skylight over the connecting passage between the two buildings were painted.[186] All of the window sashes in the Old and New Mill Houses were repaired[187] and some of the windows were re-glazed.[188] The lower-level rooms beneath the single-story structures on the north and south sides of the Engine House (originally the boiler sheds) were white-washed.[189]

A new hose and reel was purchased and maintained for use in case of fire. Presumably it was designed for the two-inch fire hose connection which had been installed on the discharge main of Turbine 3 two years earlier. [190]

The exteriors of the Old and New Mill Houses were whitewashed twice.[191] The North and South Entrance Houses, the Watering Committee Building (being used as a carpenter's shop), and the Caretaker's House were repainted.[192] The roof of the Engine House was repaired.[193]

The flagstone flooring in the interior of the New Mill House was reset.[194] The wood platforms over the flumes in the Old Mill House were removed and replaced by concrete flooring.[195] The complex's heating boiler (in the New Mill House) was repaired and the heating system's steam pipes renewed.[196]

The paint on the columns of the Pavilion was burned off; the columns were repainted

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[186] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[187] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[188] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[189] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115. Recall that prior to the 1822 conversion to water power which saw the construction of Fairmount Dam and the Old Mill House, these areas were called the North and South Boiler Sheds. The rooms on the main level had once housed the boilers for the steam engines and the rooms below had served as coal cellars.
[190] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 204; Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[191] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166; Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[192] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 165.
[193] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 165.
[194] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[195] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[196] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 171.

using paint with a fine sand component which was intended to give them the look of stone. Although the balustrade around the Forebay had been repaired and repainted two years earlier,[197] the same was now done with it.[198] The paint on the exterior of the Engine House was burned off and it too was repainted, though without using sand.[199] The refreshment stand in the central room on the main floor of the Engine House was repainted, as were the public rest rooms.[200]

The grounds likewise continued to receive attention. A park police watch-house was constructed at the northwest corner of the reservoir.[201] The basin of the South Garden's Central Marble Fountain was cleaned and reset, the paved walkway surround was renewed, and the bronze reproduction *Allegory of the Schuylkill River* was remounted.[202] Fish traps were installed in the feed pipes leading to all of the fountains.[203] Throughout the North and South Gardens and along the exterior slopes of the reservoir, trees were trimmed and dead trees were removed.[204] New gas lamps were installed in the South Garden along the southern end of the Forebay.[205] The flagstones on the Forebay Bridge were reset;[206] the tops of the piers were lowered and large decorative flower urns were installed atop both of them.[207] The balustrade around the deck of the New Mill House was extended along the north side of the Mound Dam.[208]

A fence was installed from the Forebay Bridge, north along the outer Forebay, around the

[197] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115, 116.
[198] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 169f.
[199] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 169.
[200] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 169.
[201] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85.
[202] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 84f.
[203] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 84.
[204] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85.
[205] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85.
[206] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 85.
[207] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[208] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 84. The balustrade had been extended along the south side of the promenade atop the Mound Dam and around the lengthened Pier twelve years earlier. See Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 6; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12f.

meter shop (the former auxiliary steam engine building) to the steamboat wharf.[209] The wrought iron fence at the southern entrance of the South Garden was repaired and repainted[210] and the decorative iron railing along the Cliffside Paths was repainted.[211]An additional fountain was constructed in the North Garden.[212]

The flagstone pavers on the walkway from the eastern entrance of the North Garden along the north side of the Fairmount Reservoir to the Forebay Bridge were reset.[213] The popular drinking fountain next to this walkway was renewed.[214] Drainage gutters were constructed along the Mound Dam and the reservoir walkways, as well as from the drinking fountains.[215] Numerous benches were added to the North and South Gardens and along the reservoir walkways.[216] The grades of the walkways along the slopes of the reservoir were renewed and rolled.[217] New edge borders were laid along the walkways and grassy areas in the North and South Gardens.[218]

When the tunnel of the Schuylkill River East Side Railroad was completed in 1888, under what is today called Pennsylvania Avenue,[219] the railroad company left the surrounding area a mess. The walkway along the foot of the northeast corner of Fairmount Reservoir remained unpaved and was left to the City of Philadelphia to finish at its own expense. The City installed granite curbing and asphalt pavement along 25th Street from Spring Garden Street to Green

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[209] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[210] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114, 115.
[211] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 166.
[212] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[213] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[214] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[215] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114, 115.
[216] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[217] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 115.
[218] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114.
[219] This railroad tunnel is still in use today; the rail line is currently owned and operated by CSX Transportation, a subsidiary of CSX Corporation.

Street.[220]

The entire balustrade, from the Callowhill Street Bridge to the Eagle Pavilion on the Pier at the end of the Mound Dam, was repainted using sanded paint for a simulated look of stone, as had been done earlier with the Pavilion columns and Forebay balustrade.[221] One hundred and forty trees were planted along the middle walkway of the reservoir's exterior embankment.[222] The brick pavers on the walkways in the North and South Gardens were re-laid.[223] When that was completed, 36 new benches were placed throughout the North and South Gardens.[224]

In 1889 Ogden recommended installing a turbine with a single pump in each of the two bays which formerly had housed Wheels 2 and 6 (original breast wheels 1 and 8) to provide spare water power when turbines were undergoing repair or maintenance.[225] This would have been relatively easy in the bay for Wheel 2; Ludlow had merely laid a new floor and bricked up two wall openings when he removed the inoperable breast wheel five years earlier.[226] There is no word in the record, however, regarding Ogden's intentions for the oilers' dressing room which Ludlow had constructed[227] in the bay for Wheel 6 in 1885. In any event, nothing was changed in either space.

By 1890 the connecting main from the base of the Distribution Arch at Fairmount to the Corinthian Avenue Reservoir, among the first 48-inch mains installed in the city, had been in service for 25 years. At one thirty in the morning of Monday 25 Aug it ruptured under the intersection of 26th Street and Fairmount Avenue. Water was shut off within a half hour; more

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[220] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 125f, 166.
[221] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[222] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 141, 170.
[223] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[224] Bureau of Water, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 170.
[225] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 126, 141.
[226] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 13.
[227] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 203.

impressive, the main was repaired and back in service by six o'clock that evening.[228]

Until this time, horses and wagons had been rented when needed for the use of Bureau of Water employees. Beginning in 1890, horses and wagons were purchased and stabled for permanent use in the 1st, 2nd, and 4th Wards. Ogden recommended doing the same city-wide as soon as possible. He also recommended reserving an additional horse and wagon for the exclusive use of the purveyor who had the responsibility of managing the monitoring, maintaining, and repairing of the mains, valves, hydrants, and other fixtures within each ward. The purveyors were finding it increasingly difficult to fulfill their responsibilities without immediately accessible transportation.[229]

A connecting main from the East Park Reservoir to the Lehigh Avenue Reservoir was completed in 1890 at a cost of $48,915.[230] In combination with a 30-inch main, constructed in 1887, which connected the relatively new Wentz Farm Reservoir that straddled the Lawndale and Crescentville neighborhoods to the Lehigh Avenue Reservoir,[231] this allowed the Bureau to shut down the Kensington Works[232] which drew its water from a notoriously polluted area of the Delaware River near the outlet of the Aramingo Canal.[233] Since the Fairmount Water Works supplied water to the East Park Reservoir, this meant that Fairmount was now partially supplying water to the area of the city that up to then received polluted water from the Kensington Works on the Delaware River. The result was that the detested Kensington Works was "finally

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[228] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 149, 184.
[229] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 185f.
[230] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 166f. The amount was the equivalent of approximately $1.6 million in 2022.
[231] Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 42.
[232] Water Department, *1856 Annual Report* (22 Jan 1857), 20f, 23f; Water Department, *1857 Annual Report* (21 Jan 1858), 32; Water Department, *1872 Annual Report* (30 Jan 1873), 20ff.
[233] Water Department, *1854 Annual Report* (19 Apr 1855), 22; Water Department, *1856 Annual Report* (22 Jan 1857), 13f; Water Department, *1857 Annual Report* (21 Jan 1858), 15; Water Department, *1874 Annual Report* (8 Apr 1875), 20ff. The Aramingo Canal was also known as Gunnar's Run.

abandoned in 1890,"[234] something that had long been on the wish list.[235] Its Worthington steam engine and machinery were soon dismantled and moved to the Spring Garden Works[236] to enlarge the pumping capacity there.[237]

The same year the Schuylkill Navigation Company's relationship with the City of Philadelphia became openly antagonistic once again. On Saturday 16 Jun the chief engineer of the canal company ordered the sluiceways of the Flat Rock Dam to be opened in order to facilitate repairs to the structure.[238] Although the water supply for approximately 90,000 people was drawn by the Roxborough Works from the pool behind the Flat Rock Dam, and the pool would have been drained within just a few hours, the chief engineer ignored urgent cries from City officials to close the sluices.

Since this was a Saturday, no officers of either the canal company or its owners, the Reading and Philadelphia Railroad, could be located for an appeal to good sense. After much scrambling, a judge of the Philadelphia Court of Common Pleas granted an injunction restraining the canal company from further work. It was not until officials from the Department of Public Works and the Bureau of Water showed up with a detail of police officers, however, that the chief engineer of the canal company was forced to suspend work and close the sluices. The level of the river behind the Flat Rock Dam had dropped so low, though, that pumping had to be stopped from four o'clock in the afternoon until midnight.[239]

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[234] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 142, 182.
[235] Water Department, *1856 Annual Report* (22 Jan 1857), 20f, 23f; Water Department, *1857 Annual Report* (21 Jan 1858), 32; Water Department, *1872 Annual Report* (30 Jan 1873), 20ff.
[236] The Schuylkill Works was known as the Schuylkill Works after 1876.
[237] Bureau of Water, *Chief Engineer's 1889 Annual Report* (1890), 93, 142; and Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 149, 182.
[238] Although similar in design to the Fairmount Dam, the Flat Rock Dam was a Schuylkill Navigation Company facility, constructed and operated by the canal company, not the City of Philadelphia. It was completed in 1818, two years prior to the Fairmount Dam.
[239] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 85f.

In 1892 the building at Fairmount which housed the water meter testing facility[240] caught fire and burned to the ground. All of its contents—testing equipment, tools, stored meters, and records—were a total loss. The meter shop wasn't rebuilt in the same location but a new testing facility was set up in the construction and repair shop at 918 Cherry Street where workers complained that lack of space and inadequate water pressure made the location unsuitable.[241]

During Ogden's tenure, an interceptor sewer was finally completed along the east bank of the Schuylkill River in order to begin to substantially address the increasingly polluted water which was being drawn from the river by Fairmount and the other pumping stations upriver. As early as 1856, Frederic Graff, Jr., had recommended the construction of an interceptor sewer parallel to the Schuylkill River on its east side. The proposed facility would catch waste from the 24th Street sewer (then under construction) and other drains which had been emptying directly into the river and would carry it beneath Pennsylvania Avenue to be discharged at a point below the Fairmount Water Works, thereby preventing the sewage from contaminating the water drawn at Fairmount. "The necessity of this course at an early day," he stated in his report to the mayor and Councils that year, "is quite apparent."[242] Apparent to Graff, perhaps, but not to the councilmen who would fund it. His suggestion was ignored.

Five years later, during his second tenure as Chief Engineer, Birkinbine surveyed conditions along both sides of the Schuylkill River. Reciting a litany of injuries to the Fairmount Pool, he recommended something, anything, be done to prevent residential and commercial sewage and other waste from being discharged into it.[243] In 1868 Graff asked Councils for

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[240] This was the ornamental building on the north side of the Forebay that was built in 1872 to house the auxiliary Worthington duplex steam engine. The small engine operated there until 1876 and was moved in 1878 to the Frankford Station, leaving its boiler behind. The boiler had been removed in 1883 and the building converted into a shop for the testing and fitting of water meters.
[241] Water Department, *Chief Engineer's 1892 Annual Report* (24 Jan 1893), 73.
[242] Water Department, *Chief Engineer's 1855 Annual Report* (7 Jan 1856), 5f.
[243] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 9ff.

$5,000[244] to begin surveying for an intercepting sewer, but was only given $1,000,[245] too little to accomplish the work.[246]

The same year engineers of the Fairmount Park Commission surveyed the route of a level roadway being planned for the eastern shore of Schuylkill River, from Fairmount to East Falls;[247] they included an evaluation of the feasibility of installing an interceptor sewer along its length. Graff heartily endorsed the construction of the sewer "for the purpose of conducting the objectionable drainage of Manayunk to a point below the dam."[248]

Construction of the lower portion of River Drive,[249] from Fairmount to a tunnel through Promontory Rock[250] just north of the Schuylkill Works at Girard Avenue, began in 1870 and a year later the roadway was extended upriver to just below the Laurel Hill Cemetery.[251] An interceptor sewer was not included in the project, however, but the reason is unclear. Although the Fairmount Park Commission had the authority to install water supply mains and drainage systems within the park, and had already begun to do so in other areas,[252] the construction of sewers throughout the city was the responsibility of the Department of Surveys.[253] Perhaps there was a funding issue; perhaps the size of the project caused a dispute between the agencies. Either

[244] The equivalent of approximately $104,300 in 2022.
[245] The equivalent of approximately $20,900 in 2022.
[246] Water Department, *Chief Engineer's 1867 Annual Report* (20 Feb 1868), 21.
[247] Fairmount Park Commission, *1878 Annual Report* (May 1878), 49.
[248] Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 15.
[249] When a similar roadway was later built along the western shore, River Drive was renamed East River Drive and the western roadway was named West River Drive. Today East River Drive is known as Kelly Drive and West River Drive is known as Martin Luther King, Jr., Drive.
[250] Working from both ends, workers drilled and blasted the tunnel using electrically ignited explosive cartridges. The tunnel was bored through on 9 Mar 1871 and opened to carriage traffic on the eve of Independence Day four months later. The tunnel still serves vehicular traffic today. See Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 34f.
[251] Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 2f; *Fairmount Park Commission 1878 Annual Report* (May 1878), 49, 52.
[252] Fairmount Park Commission, *1869 Annual Report* (29 Jan 1870), 61; Fairmount Park Commission, *1871 Annual Report* (31 Jan 1872), 13, 31, 42, 50, 92, 101f.
[253] "An Act to Incorporate the City of Philadelphia," *Laws of the General Assembly of the State of Pennsylvania, Passed at the Session of 1854,* No. 16, §27 (Harrisburg: Boyd Hamilton, 1854), 37.

way, a golden opportunity was lost.

The sewage draining into the Schuylkill River from Manayunk became bad enough that the City Solicitor took the unusual step in 1872 of bringing suit against some of the mill owners in the area in order to restrain them from polluting the river unnecessarily, but City Councils suspended the proceedings. Referring to laws already passed to prevent the fouling of the Schuylkill, Graff railed:

> The parties in question are still permitted (by the virtual sanctions of Councils) to violate all the laws of justice and common decencies of life by continuing to discharge foul matter into the river wantonly and unnecessarily. It is to be regretted that the measures provided for such cases by the wisdom of the State Legislature should not be rigidly enforced.[254]

Three years later, on 5 Jun 1875, Councils authorized Mayor Stokley to appoint a commission of experts to examine the city's water supply. Of eight engineers nominated by the Franklin Institute, the mayor appointed five—one from Manhattan, one from Brooklyn, one from upstate New York, and two from Philadelphia—and added William H. McFadden who was Chief Engineer at the time. The commission recognized the increasing contamination of the Schuylkill River below Manayunk. Among its recommendations was "the building of an interceptor sewer on the east side of the Fairmount pool, or of a conduit for purer water from Flat rock dam [*sic*] to the pumping works at Belmont, Spring Garden, and Fairmount." No cost estimate for either option was provided.[255] McFadden again recommended building an interceptor sewer in 1877, this time specifying a seven-foot-diameter channel,[256] as part of a plan

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[254] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 15.
[255] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 46f.
[256] Since McFadden indicated that the Fairmount Park Commission intended to build the sewer, it likely was planned to run entirely within Fairmount Park along River Drive.

for a city-wide sewerage system he had developed.[257] Still, no action was taken.

Another decade, another board of experts. In 1882, with authorization from Councils, Mayor Edwin S. Stuart appointed McFadden (who was still Chief Engineer), Graff, E.S. Chesbrough,[258] and J. Vaughan Merrick[259] and tasked the panel with conducting a comprehensive examination of the city's water system and making recommendations with cost estimates. The recommendations again included the construction of an interceptor sewer along the east side of the Schuylkill River, although no estimate was provided for this particular component.[260]

By 1884 the interceptor sewer was finally under construction, however, at least at Fairmount. The work cut through the South Garden but was finished in that area by April of the following year.[261] At the same time, Councils passed an ordinance directing William Ludlow, now McFadden's successor as Chief Engineer, to "serve personal notice" to anyone "dumping refuse or discharging water-closet drainage" into the river to cease within thirty days "upon penalty of legal proceedings against them." Ludlow wryly noted, however, that this ignored all factory waste and other pollution.[262]

In early 1886 the interceptor sewer was under construction along its entire length, but Ludlow complained that although it was designed to improve the city's water supply, the Water

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[257] Water Department, *Chief Engineer's 1876 Annual Report* (2 Oct 1877), 21, 26. Acknowledging that dumping sewage into the Schuylkill River below Fairmount would turn the tidal area of the river into an open sewer in its own right, especially during summer dry periods, McFadden instead proposed tunneling the sewer diagonally from East Falls southeast to the Delaware River at Norris Street. His suggestion was not heeded.

[258] As designer of the Boston water system and Chicago sewer system, Chesbrough was a preeminent hydraulic engineer of national repute. See "Ellis Sylvester Chesbrough," *Proceedings of the American Society of Civil Engineers*, Vol. XV, Nov–Dec 1889 (New York, 1889), 160ff.

[259] Merrick was a prominent local engineer and industrialist. His father was industrialist Samuel Vaughan Merrick, founder of the Southwark Foundry, first president of the Pennsylvania Railroad, and co-founder of the Franklin Institute. See Thomas F. Rzeznik, *Church and Estate: Religion and Wealth in Industrial Era Philadelphia* (Pennsylvania State University, 2013), 161.

[260] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 157.

[261] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 159.

[262] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 42.

Department was not consulted in any way on its design or placement.[263] Reduced from an intended seven-foot diameter (which had been recommended by McFadden nine years earlier) to four and a half feet at its widest, Ludlow predicted it would soon be overwhelmed.[264]

The following year John L. Ogden took over from Ludlow; in early 1887 he described the interceptor sewer in his first annual report. It was approximately seven and a third miles long, from Manayunk to just below Fairmount. From its northern end to the Wissahickon Creek it was four feet in diameter and had a 3.7-foot-per-mile grade. From the Wissahickon to Fairmount it widened to four and a half feet in diameter and had a 2.11-foot-per-mile grade. Flushable from either its northern end or at the Wissahickon Creek, the interior was smoothly surfaced with Portland cement. It was calculated to be capable of discharging 48 cubic feet per second or 1,250,000 gallons per hour. Ogden was more sanguine about the project than Ludlow, believing it would be sufficient for the next "fifteen or twenty years." He anticipated it would be completed the same year and cost approximately $600,000.[265] It wasn't finished until over a year later, in 1888,[266] but cost about what Ogden had projected.[267]

Despite the City of Philadelphia notifying mill owners in Manayunk that it was mandatory to connect their toilet facilities to a sewer that emptied into the interceptor, obtaining compliance was an uphill battle. Two police stations had even resisted.[268] Gradually, however,

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263 Recall that the 1854 Act of Consolidation gave the responsibility of constructing sewers to the Department of Surveys, not the Water Department. The reorganization of 1887 (also known as the Bullitt Bill) changed both departments to bureaus within the Department of Public Works. See Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 37.
264 Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 41f.
265 Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 31f. The amount was the equivalent of approximately $18.7 million in 2022.
266 Water Department, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 124.
267 Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 32.
268 Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 42f; Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 124. "As usual," Ludlow complained in his annual report for 1885, "the city was among the most stubborn."

factories and residences alike were connected. By 1889 Edwin H. Fitler, Mayor at the time, reported that 29 factories, totaling 10,000 employees, and 328 other buildings had connected to a sewer.[269]

Ogden resigned on 22 Apr 1895, effective 10 May. A new mayor, Charles F. Warwick, had been elected in February and had taken office on the first of April. He appointed Thomas M. Thompson his Director of Public Works. Thompson, in turn, appointed John C. Trautwine, Jr.,[270] to replace Ogden as Chief Engineer of the Bureau of Water. Trautwine assumed the office on 3 Jun.[271]

Following his father into the engineering profession, John Cresson Trautwine, Jr. (1850–1924), became a highly respected civil engineer in his own right. After becoming a partner in his father's firm, he headed the company after the elder Trautwine's death in 1883. Prior to becoming Chief Engineer, he worked for the Water Department on the planning and engineering of the Cambria and Mount Airy Reservoirs.[272] In addition to his work in Philadelphia, he consulted on numerous other municipal water supply systems, including that of New York City. He collaborated with engineer Rudolph Hering on the translation into English of many European publications on hydraulic engineering. Throughout his life he edited multiple editions of his father's widely applied *Civil Engineer's Pocketbook*, a veritable engineering bible of its day.[273] During his tenure at the Bureau of Water, he made the reduction of the waste of water his top priority and grappled with the increasing problem of the fouling of Philadelphia's water

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[269] Water Department, *Chief Engineer's 1889 Annual Report* (20 Jan 1890), 12.
[270] Pronounced TROUT-wine.
[271] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 42; "Obituary [John L. Ogden]," *Engineering News*, Vol. L, No. 18 (New York, 29 Oct 1903), 258.
[272] The Cambria Reservoir was not constructed.
[273] *Municipal Engineering,* Vol. XXVII, No. 6 (Dec 1899), 369; Willi H. Hager, *Hydraulicians in the USA 1800–2000* (London: CRC Press, 2015), 2645.

sources.[274]

Significantly, by the end of Ogden's term, very little information about maintenance or improvement to the machinery, buildings, or grounds of the Fairmount Water Works was being reported in the Chief Engineer's annual reports. This continued into the term of Trautwine.[275]

Some improvements were nonetheless reported. In 1896, Trautwine initiated a reconstruction of virtually all of the inner surfaces of the embankments and partitions of the Fairmount Reservoir, what he described as "a most unsightly collection of linings of many different kids and mostly in quite dilapidated condition."[276] The wood portions of the partitions were taken down to the level of the solid masonry and rebuilt using stone quarried in Conshohocken. The surfaces of the inner slopes of the outer embankments were removed and the banks were regraded with gravel. A uniform concrete surface was laid on all of the embankments and partitions. Brick stop-houses were built over all of the valve locations. The work took two construction seasons to complete.[277]

Reports of other work at Fairmount were increasingly spotty. The same year the improvements to the reservoir were completed, general repairs were made to all of the turbines and their pumps.[278] At the same time Trautwine reported that "the wheel houses and grounds at this station have been kept in fair condition, considering the means available" but, as with the turbines, provided no specifics.[279]

[274] See the next chapter for a further examination of both of these issues.
[275] Cf. Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 114ff, Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 19ff, 71ff, 147ff; Bureau of Water, *Chief Engineer's 1891 Annual Report* (30 Jan 1892), 60ff, 102f, 132ff; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 42ff, 164ff.
[276] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 92.
[277] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 92; Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 108.
[278] Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 108.
[279] Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 108.

The scant “means available” were having a significant deleterious effect, however. The exception to the “fair condition” of the buildings and grounds, Trautwine reported, was the New Mill House. In 1896 he noted that because of the perennially leaky roof the condition of the interior was so bad, and the appearance of the turbines and pumps so unsightly, that the building had been closed to the public “for some years.” He requested $20,000[280] to repair the “dilapidated” roof.[281] In 1898 Trautwine reported the conditions were causing material deterioration of the machinery. He called the ongoing[282] situation “disgraceful” and described the closure as “for decency’s sake.”[283] Despite repeated pleas for funds to repair the roof, none was forthcoming from City Councils during Trautwine’s term.

During this time the relationship with the Schuylkill Navigation Company, and its owner the Philadelphia and Reading Railroad, continued to be antagonistic. Although Trautwine had established a policy of operating the turbines at Fairmount only when water was flowing over Fairmount Dam,[284] all of the other pumping stations on the Schuylkill continued to operate. The Bureau of Water, like its predecessor the Water Department prior to 1887, had continued the habit of drawing down the water below the top of the dam whenever it believed necessary. By Trautwine’s own admission, this happened “frequently.”[285] Whether by water power or steam, however, the effect was the same—below a certain point, the canal could not operate.

With the agreements from 1819, 1820, and 1824 in hand, as well as the company charter of 1815 and the Pennsylvania Supreme Court decision of 1871, the canal company sued the City

[280] The equivalent of approximately $705,200 in 2022.
[281] Bureau of Water, *Chief Engineer’s 1895 Annual Report* (20 Jan 1896), 75f, 171.
[282] Bureau of Water, *Chief Engineer’s 1896 Annual Report* (5 Apr 1897), 47; Bureau of Water, *Chief Engineer’s 1897 Annual Report* (26 Jan 1898), 81.
[283] Bureau of Water, *Chief Engineer’s 1897 Annual Report* (26 Jan 1898), 46, 81.
[284] Bureau of Water, *Chief Engineer’s 1895 Annual Report* (20 Jan 1896), 133; Bureau of Water, *Chief Engineer’s 1896 Annual Report* (5 Apr 1897), 82.
[285] Bureau of Water, *Chief Engineer’s 1896 Annual Report* (5 Apr 1897), 82.

of Philadelphia in May 1895 to prevent the Bureau of Water from drawing the water level down any lower than the top of the dam.[286] In a letter to Trautwine on 23 Sep, the canal company's engineer and superintendent, Edwin F. Smith, protested that along the company's entire canal system, the only place where there was a navigability problem was on the Fairmount Pool:

> There is no scarcity of water whatever for navigation purposes anywhere on the river. Our dams are all brim full, and there is scarcity at Fairmount only because the Department insists upon doing the wrong thing.[287]

Four days later Smith remonstrated, "The City certainly has no right to expect that the [canal] company shall use its storage water to keep the pumping stations on Fairmount dam [*sic*] going."[288]

In April of the next year, Martin Gallagher, a canal boat captain, sued the City for $140 in damages[289] after his canal boat had been detained by low water when the Bureau drew the level down to four inches below the comb of the dam. The Court found for the plaintiff, but reduced the award of damages to $70.[290]

Trautwine griped that with the Schuylkill Navigation system's traffic having "dwindled almost to zero…the chief value of the canal property now seems to reside in its function as a thorn in the flesh of the City."[291] Mocking the canal as "nearly, if not quite, a thing of the past,"[292] he suggested the company dredge its own facility if it wanted to ensure passage for its

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286 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 131.
287 Edwin F. Smith to Trautwine, 23 Sep 1895, quoted in Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 131f.
288 Edwin F. Smith to Trautwine, 27 Sep 1895, quoted in Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 132.
289 The equivalent of approximately $5,000 in 2022.
290 Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 82f. The amount was the equivalent of approximately $2,500 in 2022.
291 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 132.
292 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 132.

boats.[293] Trautwine recommended "purchase of its works by the City," presumably to put both the Schuylkill Navigation Company and the City of Philadelphia out of their collective misery,[294] but this was never done.

As the city grew, so of course did the water supply system and with it the administrative apparatus necessary to manage it. Over the years, however, the offices of the Water Department and its successor, the Bureau of Water, were housed in a series of cramped accommodations that underserved both the administration and its customers. By 1861 Birkinbine had repeatedly called for an increase in office space and a consolidation of the various facilities at one location. At the time there were three separate offices—one at the Fairmount Water Works, one at 918 Cherry Street (collocated with the construction and repair shop), and the Registrar's office at 5th and Chestnut Streets where many residents and business owners paid their water rents in person. Besides being crowded and inconvenient for customers, the divided offices prevented the Department from organizing itself more effectively.[295]

The Water Department finally moved many of its offices into a single facility, called Spring Garden Hall,[296] at the northwest corner of 13th and Spring Garden Streets in 1874, during McFadden's tenure.[297] The continued growth of the Department, however, quickly made these quarters obsolete. Within eleven years McFadden's successor, William Ludlow, was pleading for

[293] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 131.
[294] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 133.
[295] Water Department, *Chief Engineer's 1858 Annual Report* (12 Jan 1859), 12; Water Department, *Chief Engineer's 1858 Annual Report* (9 Feb 1860), 12; Water Department, *Chief Engineer's 1860 Annual Report* (12 Feb 1861), 12.
[296] Constructed in 1848 and demolished in 1892, Spring Garden Hall (later called Commissioner's Hall) housed the mayor's office, police headquarters, and other municipal offices of the Spring Garden District prior to 1854 and the district's consolidation into the City of Philadelphia. The Greek Revival structure featured a large clock tower and grand portico of six Corinthian columns. See "Spring Garden Hall," *The Library Company of Philadelphia,* <https://digital.librarycompany.org/islandora/object/Islandora%3A59968>, accessed 1 Oct 2020.
[297] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 7; Bureau of Water, *Chief Engineer's 1898 Annual Report* (20 Jan 1899), 86.

more appropriate accommodations.[298]

The building consisted of three floors of approximately 3,500 square feet each. Remarkably, the Water Department was not the sole tenant. A branch office of the Gas Works took up most of the first floor and the entire second floor was occupied by a Grand Army Post.[299] The Registrar's offices consisted of a handful of rooms at the back of the building, into which 37 employees, their desks, equipment, and records were shoe-horned. The Registrar not only collected the water rents for the entire city, but it also managed the permitting of builders, plumbers, and others. While the clerks were crowded elbow-to-elbow, members of the public had to enter from the rear and were forced to wait in a yard behind the building, standing on the bare ground and exposed to all weather, often for hours at a time.

The third floor contained offices for the Chief Engineer, his Assistant Engineers, the General Superintendent, draftsmen, and associated clerks, 26 people in all. Ludlow reported that the third floor received all of the noise from below, as well as the coal and sewer gasses from defective flues and pipes.

The building was poorly constructed and difficult to maintain. The heating system didn't work and it had poor ventilation and drainage. Typical for Ludlow, he emphasized the adverse effect the building's environment had on the health of the employees who worked long hours there. He thought the conditions were not fair to either the employees or the public they served. Ludlow also worried that it was a fire trap. He mused that although a fire might ultimately be beneficial (assuming no one was hurt), the destruction of indispensable maps, records, and other

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[298] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 35ff.

[299] A Grand Army Post was a local unit of the Grand Army of the Republic, a Civil War veterans' organization founded in 1866. Veterans met together in local posts, similar in fashion to members of today's American Legion and Veterans of Foreign Wars. See Albert E. Smith, Jr., "The Grand Army of the Republic and Kindred Societies," *Library of Congress* (last updated 17 Jan 2002), <https://www.loc.gov/rr/main/gar/>, accessed 27 Aug 2020.

documents and property would be unacceptably costly.

Ludlow thought the situation was a disgrace:

> The space is entirely inadequate. There is not a single room sufficient to its special purposes nor one having the most ordinary accommodations and facilities for business. Even supposing that the entire building were available instead of a half only—and that the least convenient and desirable—it would still be totally unsuitable as the headquarters of a great city department, whether in point of space, sanitary condition, interior arrangements or accessibility.[300]

"A proper administration of the affairs of the Department in its relation both to the public and to other branches of the City Government," Ludlow concluded, "requires that suitable quarters be obtained for it, even should this temporarily involve some cost."[301]

The following year he continued his appeal, underlining the human aspect:

> I renew my recommendation that without further delay such decent and suitable facilities for the transaction of the Department business be procured as shall serve the public interest, and conserve the health and well-being of the public servants. To one who has visited the headquarters of the Water Department and seen the long lines of old people, cripples and children exposed to every inclemency of weather, and the crowded condition of the Registrar's clerks who with every discouragement seek to perform their duties, no argument seems necessary. … It seems unworthy of the city that a department of such large transactions and which has been made to return so large an unearned revenue, should be provided with quarters so contracted and be subject to such unsanitary and unwholesome influences.[302]

[300] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 36.
[301] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 37.
[302] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 139f.

Since there just wasn't enough space to accommodate the functions of the Department, Ludlow went begging for more. The U.S. Postmaster in Philadelphia offered him temporary space in the new Post Office building at 9th and Chestnut Streets for some of the draftsmen.

In 1888, many of the Department functions, including the Registrar's office, were moved to the second and third floors of a rented facility at the northeast corner of Juniper and Filbert Streets, across from the northeast corner of the new City Hall then under construction. Spacious and well-lit, it was a much more central and convenient location for water customers.[303]

Eight years later some portions of the interior of City Hall were still not finished[304] but many municipal offices were beginning to be relocated to the huge new building. The Bureau of Water's Chief Engineer at this time, John C. Trautwine, had originally considered asking for "two large rooms and the intervening hall" on the west side of the ninth floor for the offices the public would not need access to, but after realizing there was no elevator access that high opted instead for the seventh floor. Offices the public needed to visit, like the Registrar's office, were to be given a suite of rooms on the first floor. The commission in charge of constructing City Hall decided, however, to give the ground floor offices to the Bureau of Gas and place the Bureau of Water's public access offices on the fifth floor. Trautwine must have protested effectively, because in the end the commission relented let him have the first floor.[305]

While planning for the move, Trautwine submitted the necessary request for office

[303] Bureau of Water, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 103; Bureau of Water, *Chief Engineer's 1898 Annual Report* (20 Jan 1899), 86.
[304] Since 1791, core municipal offices had been located at City Hall at 5th and Chestnut Streets, in a two-story building on the east side of the Pennsylvania State House (today known as Independence Hall). Ground was formally broken for a new City Hall on Penn Square on 16 Aug 1871; construction was completed on 31 Jun 1901. Originally projected to cost approximately $10 million, it came in at nearly $25 million. It is still today the largest municipal building in America. See Bureau of City Property, *Directory of Philadelphia City Hall* (Philadelphia: Dunlap Printing Co., 1908), 24ff, 38ff, 43f; Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 173f, 223, 369, 425f; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 23f.
[305] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 126f.

furniture to the commission's architect, W. Bleddyn Powell, and estimated it would cost no more than $25,000[306] even at the high end. Such was the manner of municipal politics that Powell reported back that the furniture would in fact cost over $200,000,[307] more than eight times as much. The architect didn't give a reason, but didn't seem to have a problem with it. Trautwine was floored. "What manner of furniture it is proposed to furnish us, to bring the cost to any such figure,' he marveled, "I am at a loss to conjecture."[308]

The Bureau moved into its new home in City Hall in 1898. The Registrar's office received customers in Room 196, a large room immediately to the west of City Hall's north portal. Other public offices ranged from there to the northwest corner of the building. A few functions, like the permit office, did land on the fifth floor. Executive, engineering, draftsman, and other administrative functions were organized in rooms on the seventh floor. The Chief Engineer occupied Room 710, with his assistant engineers residing nearby. The remainder of the Bureau filled virtually the entire northwest quadrant of the seventh floor and half of the northeast. The Bureau of Water seemed at last to have sufficient room in one place to organize as its officers thought best and to be able to interact with the public in a way that was convenient both to the public and to Bureau employees.[309]

In 1896 Trautwine noted something which at first glance would appear to be merely a minor annoyance but which would certainly have increased costs to the Bureau and like much else was probably politically motivated. Whenever the Bureau of Water, or any other City agency, needed to advertise for bids on work, services, equipment, or materials, it was restricted

[306] The equivalent of approximately $892,100 in 2022.
[307] The equivalent of approximately $7.1 million in 2022.
[308] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 127.
[309] Bureau of Water, *Chief Engineer's 1898 Annual Report* (5 Apr 1897), 86; Bureau of City Property, *Directory of Philadelphia City Hall* (Philadelphia: Dunlap Printing Co., 1908), 8, 10f, 22f.

to doing so in three local newspapers, one of which was a German publication. Frustrated, Trautwine urged Councils to change the regulation to allow for advertisement in regional and national engineering journals, as other cities do, in order to attract the best response at the lowest cost to the City.[310]

In February of 1899, Samuel H. Ashbridge was elected mayor, taking office in April. The new mayor appointed William C. Haddock the Director of the Department of Public Works. On 8 Nov Trautwine resigned over policy differences with Mayor Ashbridge and Haddock appointed Frank L. Hand Chief of the Bureau of Water, effective 15 Nov.[311]

Hand was born in Cape May, New Jersey, and moved with his family to Philadelphia at an early age. At the outbreak of the Civil War he enlisted as an engineer in the U.S. Navy. When the ship he was serving aboard was wrecked he spent several months as a POW in a Confederate prison. After the war, Hand served as a marine engineer on commercial steamers. In 1872 he was appointed a U.S. Inspector of Steam Vessels and stationed in Philadelphia. Hand had been General Superintendent of the Department, then Bureau, since his appointment to that position by Ogden in 1886.[312]

During a prolonged dry spell in the summer of 1900, Hand took advantage of the "unusual number of days when water did not flow over Fairmount Dam" to inspect the structure and rehabilitate it where necessary. Along the downstream face of the dam, he replaced 133 timbers, each 10 inches by 10 inches and 16 feet long. He recommended a thorough overhauling.[313]

Two years later, conversely, the spring and summer was unusually wet. Flooding

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[310] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 142f.
[311] Bureau of Water, *Chief Engineer's 1899 Annual Report* (20 Jan 1900), 40, 61.
[312] *Official Handbook, City Hall, Philadelphia, 1901–1902* (Philadelphia: City Publishing Co., 1901), 31.
[313] Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 77.

occurred during the second week of March, with the Schuylkill River rising at one point to 10 feet, nine inches above the top of Fairmount Dam. Part of the protective fender cribbing at the corner of the Pier was torn away. The concrete fill between the upstream and downstream structures of the dam broken apart, allowing "great quantities of water" to wash through the dam, estimated by Hand to be equal to the average daily amount pumped out of the Fairmount Pool.[314]

The Director of Public Works estimated the cost of necessary repairs to be approximately $20,000.[315] Despite the urgency—the Schuylkill River supplied 80 percent of the city's water at the time—Councils failed to supply the necessary funding.[316]

In February 1904 the downstream structure was "badly damaged" by ice floes during a freshet.[317] In some places, most of the timbers and fill had torn loose and been carried away, leaving large portions of the downstream structure almost entirely missing. Much of what remained was obviously decayed.[318]

A cofferdam was constructed above Fairmount Dam and the entire structure was inspected. Although only the lower structure was found to be damaged, the upper structure was allowing water to pass through it as well. It was also discovered that the fill between the two structures, which was supposed to be entirely concrete, was in fact mostly earthen fill with only a veneer of concrete at the top. This was evidently one of the reasons the concrete had broken apart so much.

The inspection also revealed that the lower structure had shifted away from the upper structure, widening the space between the two. Apparently once the out-of-spec fill between the

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314 Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 114.
315 The equivalent of approximately $688,800 in 2022.
316 Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 38.
317 Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), xxxviii, 35f, 82f.
318 Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 82, and four photographic plates at 82.

two structures began to deteriorate and allow water to attack the lower structure from behind, the resulting hydraulic pressure slowly pushed the lower structure out of position. This worsened the erosion of the fill, which further increased the pressure on the lower structure. The two factors reinforced each other. With water and ice allowed to attack the lower structure both from without and from within, eventually its integrity was seriously compromised and it began to fail.[319]

Worse, the Director of Public Works concluded that the staggering amount of water passing through the dam had been a major contributing factor in the drawing down of the river below the legal level necessary for operation of the Schuylkill Navigation system, with the consequence that "the City has frequently been embarrassed by law suits," not to mention the exposure to the risk of water shortage.[320]

On 15 Jul 1904 Councils finally appropriated $15,000 for repairs[321] and work got under way soon after. Even as work was ongoing, however, the amount turned out to be insufficient, as was projected two years earlier by the Director of Public Works. In order to complete the repairs Councils was forced to appropriate an additional $10,000 on 26 Nov.[322] Thorough in nature, the repairs took two years to complete. All missing and defective cribbing timbers were replaced, stone ballast was replaced where it had washed out, and the entire dam was resurfaced with new wood beams. Leakage through the dam was reduced to a minimum.[323] The space between the upper and lower structures was filled with concrete consisting of finely crushed rock and cement, thoroughly tamped into place with grout.[324] The work cost $14,863 in 1904, $6,490 in 1905, and

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[319] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 82.
[320] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 82.
[321] The equivalent of approximately $499,200 in 2022.
[322] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 82f. The amount was the equivalent of approximately $332,800 in 2022.
[323] Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 61.
[324] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 83; Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 61.

$3,698 in 1906. In all, the project cost a total of $25,051.[325]

At this time billing for water service was still mostly on the basis of the number and type of fixtures, or "water appliances," on a customer's property. As we have seen, many property owners had a habit of installing fixtures without registering them. Periodic re-inspection was necessary to bring water rents into compliance with actual points of service.

The last canvass had been completed in 1884 when 20 inspectors under Ludlow had examined 160,000 properties. Another was again needed. Hand added 28 temporary inspectors to the permanent force of three and paid the new hires laborers' wages. From April 1900 to Aug 1901, 248,226 properties were examined, with approximately 5,000 scrutinized twice. Of the total, 40,418 properties were found to have 70,660 fixtures for which no water rent was being paid. The re-inspection more than paid for itself. Its one-time cost was $26,447[326] while it generated a total water rent correction of $146,057 per year,[327] leaving a net revenue increase of $119,610 for the first year alone,[328] with the full increase collected each year thereafter.[329]

In February of 1903 the cast iron main shaft of Turbine 5 broke apart, causing the turbine to seize while running at full speed. The enormous torque of the moving rotor fractured the cast iron casing and twisted the pedestals upon which the casing rested. A newly manufactured shaft was purchased and the casing was repaired with wrought iron boiler plate.[330]

The next year, Turbine 5 again required substantial repairs, as did Turbine 9. Both wheels

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[325] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 83; Bureau of Water, *Chief Engineer's 1905 Annual Report* (19 Jan 1906), 59; Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 61. The three amounts total approximately $824,400 in 2022 currency.
[326] The equivalent of approximately $921,500 in 2022.
[327] The equivalent of approximately $5.1 million in 2022.
[328] The equivalent of approximately $4.2 million in 2022.
[329] Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 25, 68, 76; Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 16, 77.
[330] Bureau of Water, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 42, 103.

were inoperative long enough to have a serious affect on pumpage at Fairmount.[331]

In January 1906, Turbine 5 broke down again. This time the coupling between the two sections of the runner shaft broke, causing the turbine casing to be "badly fractured" once more. In order to avoid the cost of replacing both portions of the shaft, a new coupling was secured by heating and shrinking wrought iron bands around the flanges of the shafts and installing a second set of bolts instead of one set as originally designed. The casing was again repaired by riveting wrought iron boiler plate to the exterior. The work required the construction of a cofferdam around the tail race so water could be pumped out of the wheel pit.[332]

Two months later the bevel wheel which drove the runner shaft of Turbine 8 broke apart. Unlike the earlier breakdowns, however, this one caused little damage. A new bevel wheel was fabricated and minor repairs were made.[333]

In the New Mill House, the machinery continued to suffer from the leaking roof. In 1901 Hand noted, "The engine room and pumps are now in a most deplorable condition."[334] Early the next year he declared it was "impossible to keep turbine wheels Nos. 7, 8 and 9…in a presentable condition as long as the leaky roof over them remains in its present deplorable need of repair" and renewed his call for funds to fix the roof.[335] Later in 1902 a severe freshet submerged all of the equipment in both mill houses and caused "considerable damage" to the buildings.[336] Although repairs were promptly made throughout all of the buildings, the interior of the New Mill House was left as it was. Because of the leaky roof, improving it would have been

[331] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 77.
[332] Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 61f. Most of the exit gates on the river sides of the tail races had likely long since ceased to be watertight.
[333] Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 62.
[334] Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 64.
[335] Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 96.
[336] Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 36, 116. The level of the Schuylkill River rose to ten feet, nine inches above the top of Fairmount Dam.

a waste of time, money, and materials.[337]

After years of receiving no help from Councils, Hand finally made repairs to the deck roof with existing funds and materials he scraped together from what was available within the Bureau.[338] He removed the existing concrete surface and re-laid it using concrete with a higher cement component for increased strength.[339] In order to prevent cracking and accommodate the expansion and contraction caused by normal hot and cold weather cycles, he had the new surface laid in 40-foot-square sections separated by narrow tar-filled expansion joints. The entire surface was graded with an increased pitch to facilitate drainage. Lastly, the concrete was sealed with three applications of Sylvester's wash.[340] When the roof did not leak after a year of expansion and contraction cycles, Hand finally had the interior of the New Mill House repainted and otherwise made presentable.[341]

In what is virtually the last mention of the grounds of the Fairmount Water Works in the Bureau of Water's annual reports, Hand rather perfunctorily noted in 1900 that the "grounds received every attention necessary to keep them in first-class condition."[342]

Because of the perceived monetary economy of water power, in 1902 Hand thought it

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337 Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 116.
338 Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 86f.
339 In ordinary vernacular English, the terms "concrete" and "cement" are often used interchangeably. Cement, however, is one of the ingredients, or components, of concrete, not the finished product itself. It can be thought of as the glue that binds the concrete together. As with epoxy, concrete does not harden by drying but instead "sets" through chemical reaction and transformation.
340 "Sylvester's wash" was at the time a common method of sealing concrete surfaces against moisture penetration. See U.S. Department of Agriculture, *Farm Building and Equipment Plans and Information Series* (1929), 21f. From the USDA: "Sylvester's wash has long been used for waterproofing brick work and concrete which has hardened and dried out. It consists in the alternate applications of alum and of soap solutions…. A coat of the soap solution is first applied…. This is left for 24 hours or until the surface is entirely dry. A coat of the alum is then applied and allowed to dry for another 24 hours. This is followed with another coat of soap and another of alum at similar intervals. Two pairs of coats should be sufficient for any ordinary case, though additional ones may be applied if required. The effect of this treatment is to form a more or less insoluble compound of calcium soap in the outer pores of the concrete, this soap filling the pores and acting as a water-repellent. It is one of the most effective treatments which can be given a concrete surface, however it becomes less effective with age."
341 Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 87.
342 Bureau of Water, *Chief Engineer's 1899 Annual Report* (20 Jan 1900), 84.

"highly desirable to continue [the Fairmount Water Works] in service to the fullest extent possible."[343] Four years later, however, he acknowledged that the Bureau of Water intended to abandon Fairmount when an immense pumping and filtration system then under construction in the Torresdale neighborhood of northeast Philadelphia was completed. In light of this decision, he advised against any significant work to Fairmount's aging machinery.[344]

Hand resigned effective 8 Mar 1906 and the Director of the Department of Public Works appointed Allen J. Fuller to temporarily replace him. Fuller had been hired as a draftsman by McFadden in 1873 and was promoted to Assistant Engineer by Ludlow in 1884. When Hand was appointed Bureau Chief in 1899, he had appointed Fuller to succeed him as General Superintendent. For a little over a year and a half, Fuller headed the Bureau from his position as General Superintendent while a search was made for a permanent replacement who would pass the Civil Service examination.[345]

In 1907 the leadership issue was rendered moot. Early in the year John E. Reyburn was elected mayor. On 15 Oct, on Reyburn's recommendation, City Councils passed an ordinance folding the recently created Bureau of Filtration into the Bureau of Water.[346] Frederick C. Dunlap, who had been Chief Engineer of the Bureau of Filtration since 1 May, was appointed Chief Engineer of the Bureau of Water by the Director of Public Works.[347] Fuller retained his position as the Bureau of Water's General Superintendent. Dunlap served as Chief Engineer of

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[343] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 83.
[344] Bureau of Water, *Chief Engineer's 1905 Annual Report* (19 Jan 1906), 60.
[345] Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), lviiif, 45.
[346] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 26, 46. The short-lived Bureau of Filtration had been created on 1 Aug 1902, by ordinance of City Councils on 18 Jul 1902, to manage the implementation of city-wide filtration of the water supply. See Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 45f.
[347] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 26, 45f. Prior to being appointed Chief Engineer of the Bureau of Filtration, Dunlap had been managing the construction of the massive Torresdale Filtration Plant as an Assistant Engineer. See Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 225; Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 217.

the Bureau of Water until 1912.[348]

Except for a "thorough overhauling" of one of Turbine 3's pumps during 1907,[349] no further mention of any work on the machinery, buildings, grounds, or reservoir at Fairmount appears in any of the subsequent annual reports.

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The completion of the full transition from breast wheels to turbines in 1872 had begun a second golden age for the Fairmount Water Works.[350] The facility had hit its stride as a pumping station. Annual output increased from a little over 7.2 billion gallons in 1872[351] to nearly 9.5 billion in 1877.[352] The year 1890 saw the highest annual pumpage ever, over 12.3 billion gallons.[353] The surrounding grounds were at the peak of their beauty. Visitors still visited the South and North Gardens and climbed the cliffside paths and walkways around the Fairmount Reservoir.

Within twenty years of its build-out, however, Fairmount's pre-eminence among the city's pumping stations had all but vanished. It never again achieved the output it did in 1890. Whereas in 1872 it pumped 55.1 percent of the city's total water supply,[354] even in 1890 its

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348 Bureau of Water, *Chief Engineer's 1912 Annual Report* (13 Feb 1913), 45. After this, Dunlap would go on to serve as Chief Engineer of the Department of City Transit, Chief of the Bureau of Surveys, and in the 1920s again as Chief Engineer of the Bureau of Water. See *Engineering News-Record*, Vol. 90, No. 24 (14 Jun 1923), 1063.
349 Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 56.
350 The first being the period after the completion of the initial water powered system in 1822 and especially after the completion in 1835 of the South Garden and other improvements to the grounds.
351 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 33.
352 Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878), 62.
353 Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 140.
354 Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 33, 46.

contribution had dropped to 24.6 percent.[355] By 1902 it was a vestigial 6.7 percent.[356]

In 1896 Chief Engineer John C. Trautwine, Jr. noted that while Fairmount in 1875 was the cornerstone of the city's water supply system and the steam-powered pumps at the Spring Garden Works and elsewhere were used as an auxiliary, by 1895 it was the opposite. Spring Garden pumped more than all other stations combined and Fairmount had become the auxiliary.[357]

This was because Fairmount's machinery was increasingly costly to operate, both in terms of money expended and in terms of water expended. And the latter had become the more important of the two. As the demand for water rose and more water was drawn from the Schuylkill River, the river's water budget became increasingly tight, causing the Fairmount Water Works to be used less as time went on.

Regarding monetary cost, in 1876, and again in 1878 and 1880, McFadden argued that the true cost of water power was much more than had been reported. He went so far as to call the idea that water power at Fairmount was far less expensive than steam a "delusion." This would have been a bracing assertion; it was a long-held and cherished belief that water power was more economical than steam. To most, it was beyond question.

Frederic Graff, Jr. and chief engineers before him had confidently asserted that water power at Fairmount was far less expensive in terms of relative cost of operation than the steam power that was the motive force at all other pumping stations.[358] Immediately after Graff's final tenure, however, McFadden maintained that operating expenditures were not the only costs

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[355] Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 140.
[356] Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), 116, 125.
[357] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 129f.
[358] For example Cassin in Water Department, *Chief Engineer's 1863 Annual Report* (28 Jan 1864), 11ff; Birkinbine in Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 16ff; Graff in Water Department, *Chief Engineer's 1871 Annual Report* (8 Feb 1872), 15ff; Graff in Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 6f.

which should be taken into account. He argued that if capital costs were included—like the cost of construction, the cost of the purchase and installation of machinery, and the interest on the loans necessary to fund the initial capital outlay—water power cost as much or more than steam power.[359] He also argued that at Fairmount the capital costs of constructing, reconstructing, and maintaining Fairmount Dam should be included in the cost of pumping. McFadden provided multiple cost analyses over a number of years and urged that all further expansion of pumping capability be steam-powered.[360]

After McFadden's departure, though, it wasn't long before subsequent chief engineers ignored his analysis, reverted to comparing only operational expenses, and were again crowing about Fairmount's "great saving."[361] In a case of watch-what-I-do-and-not-what-I-say, however, no expansion or significant improvement to Fairmount's water power capacity was implemented after 1872. Although McFadden himself briefly floated a proposal to add three more turbines in an expanded New Mill House, not only was this not done but he never mentioned it again, probably because he realized that additional turbines would only help during cooler or wetter weather when the additional water power capacity wasn't needed as much.[362]

Dollars and cents, however they were reckoned, were not the only cost of running Fairmount's turbines. There was also a cost in terms of water—not the price of water, but the

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[359] Prior to McFadden, capital interest had sometimes been included, but capital principal virtually never was. See for example Birkinbine in Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 16ff.

[360] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 53ff, 66; Water Department, *Chief Engineer's 1877 Annual Report* (3 Oct 1878),11ff; Water Department, *Chief Engineer's 1879 Annual Report* (29 Apr 1880),18f; Water Department, *Chief Engineer's 1880 Annual Report* (1881), 25.

[361] For example Ludlow in Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), table at 126; Ludlow in Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), table at 220; Ogden in Bureau of Water, *Chief Engineer's 1887 Annual Report* (2 Jan 1888), 53; Trautwine in Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 174; Hand in Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 72. Even McFadden eventually did this. See Water Department, *Chief Engineer's 1880 Annual Report* (1881), 25. It was true that strictly in terms of operating expenses, Fairmount was less expensive to operate on a daily basis than any other station.

[362] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 12.

literal amount of water itself that was needed to run the turbines and operate the pumps. Between the two costs, the amount of water had by far the most impact.

The City of Philadelphia may not have needed to purchase coal to fuel the turbines, but it did need to "expend" water. Recall that in the summer of 1870, during the trying of the lawsuit brought against the City by canal boatman Collins, Frederic Graff, Jr. estimated during his testimony that the turbines used 13½ gallons to pump each gallon of water to the reservoirs.[363] By 1896 Trautwine would record that the measured figure was 30 gallons, more than twice Graff's estimate, and declare Fairmount's turbines "extremely wasteful of water."[364] As the city's demand for water rose, this became an increasing problem, especially during dry years.

During this time over 80 percent of the city's water supply was drawn from the Schuylkill River.[365] As demand taxed the river, planners were forced to confront what might be called "The Big Question:" If the Schuylkill River struggles to keep up with the demands placed upon it,[366] should the City of Philadelphia continue to employ a system which uses 30 gallons of water to pump each gallon to a reservoir, or rely instead on systems which use virtually no water to pump each gallon? The question virtually answered itself. Indeed, unless a year was unusually wet, the Fairmount Water Works was already being shut down for various stretches of time.

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363 "The City of Philadelphia *versus* Collins," *Pennsylvania State Reports, Vol. LXVIII, Comprising Cases Adjudged in the Supreme Court of Pennsylvania,* October Term, 1870, and January and May Terms, 1871 (Philadelphia: Kay & Brother, 1872), 107.

364 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 133.

365 Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 19, 21, 23, 25, 28, 30; Water Department, *Chief Engineer's 1875 Annual Report* (16 Apr 1876), 108, 110, 112, 113, 114, 116, 117; Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 105; Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jann 1891), 140f; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 79; Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 73.

366 There were years during the summers of which no water flowed over Fairmount Dam, meaning virtually the entire flow of the river was either pumped to reservoirs, used to power Fairmount's turbines, or used to operate the Schuylkill Navigation system's locks at the west end of the dam. See for example Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 26f. See also Water Department, *Chief Engineer's 1880 Annual Report* (1881), 26; Bureau of Water, *Chief Engineer's 1890 Annual Report* (27 Jan 1891), 144; Bureau of Water, *Chief Engineer's 1893 Annual Report* (1894), 73; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 46, 171; Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 82.

After the drought of 1869 and the decisive embarrassment in court for the City of Philadelphia over the issue of drawing the level of the Schuylkill River down to the point that it compromised the operation of the Schuylkill Navigation system, successive chief engineers began to come to the realization that expending scarce water resources to pump scarce water resources just didn't make a lot of sense. As the latter half of the nineteenth century progressed, the Fairmount Water Works was increasingly perceived as unreliable, particularly when needed most.

During the summer of 1874, for example, the total demand on the system was 54 million gallons per day, but the system could only supply 50 million. Because of the dry conditions, however, Fairmount was shut down for much of the time and could not contribute anything significant. The mayor was forced to deploy police to discourage water waste.[367]

That year McFadden contended that the Fairmount Water Works was not as dependable as it once was. He pointed out that while the turbines in the New Mill House each had a theoretical pumping capacity of 6 million gallons per day, they actually only produced a little over 5 million. Those in the Old Mill House had a theoretical capacity of 8 million gallons per day, but only pumped less than 5.5 million. Factoring in a ten percent leakage rate made the performance even worse.[368]

This was at the best of times. During dry periods, the flow of the Schuylkill River was diminished and the entire Fairmount Water Works could be relied upon for a total of only 5 million gallons per day.[369] In 1880, a relatively dry year, the turbines at Fairmount pumped only 54 percent of the time due to low water conditions. Even if all seven turbines pumped one

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[367] Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 8.
[368] Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 54f.
[369] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 15.

hundred percent of the time near their theoretical capacity, McFadden argued, Fairmount could still move no more than 40 million gallons per day.[370] "The water power of the Schuylkill," he asserted, "has been highly overrated."[371] Putting an even finer point on it, McFadden concluded that "the result of all this experience should direct our attention to steam power and divert us from water power as a means for a water supply."[372]

Two years later a panel of experts comprised of E. S. Chesbrough, J. Vaughan Merrick, and (significantly) Frederic Graff, Jr., wrote in a report to McFadden, "Indeed, the time has come, when it is necessary to face the fact that during periods of least flow of water, which are also those of greatest consumption, the water power at Fairmount is practically unavailable."[373]

Ludlow, McFadden's successor, confirmed McFadden's estimate of a 5 million gallon daily capacity at least twice during his tenure,[374] once while comparing the station unfavorably with the various steam-powered plants that together could supply 74 million gallons per day during similar periods.[375] He thought the turbines consumed so much water to operate, using water to pump water, that when water was scarce it didn't make sense to run them.[376] Believing other operational considerations were more urgent, Ludlow began to recommend that improvements to the turbines be deferred.[377] A simple back-of-the-napkin calculation shows that by the late nineteenth century, the drawing of water from the Schuylkill River had reached a critical stage. What are the numbers? In 1887 hydraulic engineer Edwin R. Smith estimated the minimum flow of the Schuylkill River to be 245 million gallons per day. (This correlated well

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[370] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 22f
[371] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 22.
[372] Water Department, *Chief Engineer's 1880 Annual Report* (1881), 23.
[373] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 152.
[374] Water Department, *Chief Engineer's 1883 Annual Report* (1 Apr 1886), 4f; Water Department, *Chief Engineer's 1885 Annual Report* (Apr 1884), 25.
[375] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 4f.
[376] Water Department, *Chief Engineer's 1884 Annual Report* (Apr 1884), 12.
[377] Water Department, *Chief Engineer's 1884 Annual Report* (Apr 1884), 13.

with the calculated average available flow of a little over a quarter of a million gallons.)[378] Ludlow estimated a total of 74 million gallons per day were pumped out of the river by steam power. McFadden and Ludlow estimated Fairmount's maximum production during dry periods at 5 million gallons per day. Trautwine estimated that Fairmount used 30 gallons of water to pump each gallon.

If the total flow of the Schuylkill River were 245 million gallons per day, and the steam-powered works drew 74 million gallons, that left 171 million gallons. Subtract Fairmount's 5 million and 166 million gallons are left. So far, so good. When we deduct the amount the turbines consumed to pump their 5 million gallons, however, things get far more shaky. Remove the 150 million gallons that Fairmount's turbines used each day to power the pumps to raise the 5 million gallons and we are left with only 16 million gallons (less than seven percent of the river's total flow) to operate the Schuylkill Navigation system and act as a margin of safety.

Hardly the stuff that sleep-filled nights are made of.

We can now begin to see why the City of Philadelphia would want to utilize the Fairmount Water Works less and less as demand put an increasing strain on the supply of the Schuylkill. We can also see why Ogden, Ludlow's successor, could in 1886 declare with impunity that Fairmount was least available when needed most—during warm, dry weather.[379]

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The summer of 1892 brought a combination of severe drought and record high temperatures. Fairmount's turbines were shut down for over 18 days due to low water. Rationing

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[378] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 26.
[379] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 28.

of water had to be imposed in some parts of the city. Reservoirs were drawn down to dangerous levels. The three sections of the East Park Reservoir, for example, saw levels of 5.9 feet, 5.75 feet, and 4.9 feet as late as 8 Oct. The steam engines at all of the pumping stations were run beyond nominal capacity from summer into fall. Some of the machinery broke down under the strain. Were it not for a new steam engine which became operational at the Spring Garden Works on 15 Jun—at times running 50 percent above the contracted capacity and at one point breaking its bed-plate but continuing to be run—all of the reservoirs would have been emptied.[380]

In 1893 water failed to fall over Fairmount Dam for 278 days, over three quarters of the year.[381] The following year, Fairmount's turbines were each stopped for 72 days because of low water.[382] In 1895, the dam was dry for 265 days[383] and the turbines were idled for 58.[384] Even when Fairmount could operate, low water often prevented it from operating fully. From 7 Jul to 23 Dec of that year, there was never a time when all of the turbines and pumps were running.[385]

What McFadden had stated so succinctly in 1881 remained true—"The result of all this experience should direct our attention to steam power and divert us from water power…"[386] Successive chief engineers understood this as well. By 1895 the capacity of the seven turbines at Fairmount had been dwarfed by that of the thirty steam engines then operating across five other pumping stations.[387]

There was also a growing recognition that the flow of the Schuylkill River would not be

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380 Bureau of Water, *Chief Engineer's 1892 Annual Report* (24 Jan 1893), xxf, 14, 39f.
381 Bureau of Water, *Chief Engineer's 1893 Annual Report* (1894), 73, 108.
382 Bureau of Water, *Chief Engineer's 1894 Annual Report* (Jan 1895), 66.
383 Bureau of Water, *Chief Engineer's 1894 Annual Report* (Jan 1895), 171.
384 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 46.
385 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 46.
386 Water Department, *Chief Engineer's 1880 Annual Report* (1881), 23.
387 Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 79f. The primary pumping stations at this time were Spring Garden, Belmont, Queen Lane, Roxborough (all on the Schuylkill River), and Frankford (on the Delaware River). In addition, there were four auxiliary pumping stations: Belmont, Roxborough, Mt. Airy, and Chestnut Hill.

sufficient to meet future demand, that the future of Philadelphia's water supply lay elsewhere. Certainly, expansion of the Fairmount Water Works, with its profligate use of water, was out of the question. As Ogden announced in 1895, "Fairmount…cannot be depended upon during low water."[388] Trautwine, Ogden's successor, established a rule, followed rigorously from 1896, of operating the facility in summer only when water actually flowed over Fairmount Dam.[389]

Fairmount was stuck in a downward spiral. As demand taxed the Schuylkill River's supply, Fairmount's water-wastefulness meant that it couldn't be expanded, so steam power was added upstream. As steam power drew more water from the river and taxed its supply further, Fairmount was used less, making it less reliable. As water power at Fairmount became less reliable, steam power was increased. As demand continued to rise and more steam power was added, Fairmount was run even less.

Since Fairmount used so much water, it dare not be used during the driest periods. Because of this, its output became increasingly erratic. As its reliability decreased, it was relied upon less and less. Expansion of the water supply system occurred elsewhere. Trautwine in 1898 identified increasing the pumpage from the Delaware River as one of the Bureau of Water's top three priorities.[390] He thought it was clear that very little additional supply could be wrung from the Schuylkill River.

It is not surprising, then, that if we examine the output of the Fairmount Water Works and its contribution to the total water supply through this time (refer to Fig. 7-1, *Fairmount Water Works' Annual Pumpage and Percentage of Total System Supply, 1855–1910*), we see that Fairmount contributed a dwindling percentage of the total system supply.

[388] Bureau of Water, *Chief Engineer's 1894 Annual Report* (Jan 1895), 66.
[389] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 82.
[390] Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 69. Trautwine believed the City could not afford the size of the necessary filtration facilities unless the demand was controlled by the reduction of water waste.

In 1899 hydraulic engineer P. J. A. Maignen[391] cast the problem in stark terms.

> It is considered undesirable to increase the pumpage from the Schuylkill, as in periods of drought the pumps absorb the whole flow of the river, and sometimes draw on the reserve in the Fairmount pool, which is said to hold thirty days' supply.[392]

As demand neared the maximum limit on the Schuylkill River, it became an open question as to why the Fairmount Water Works should be operated at all.

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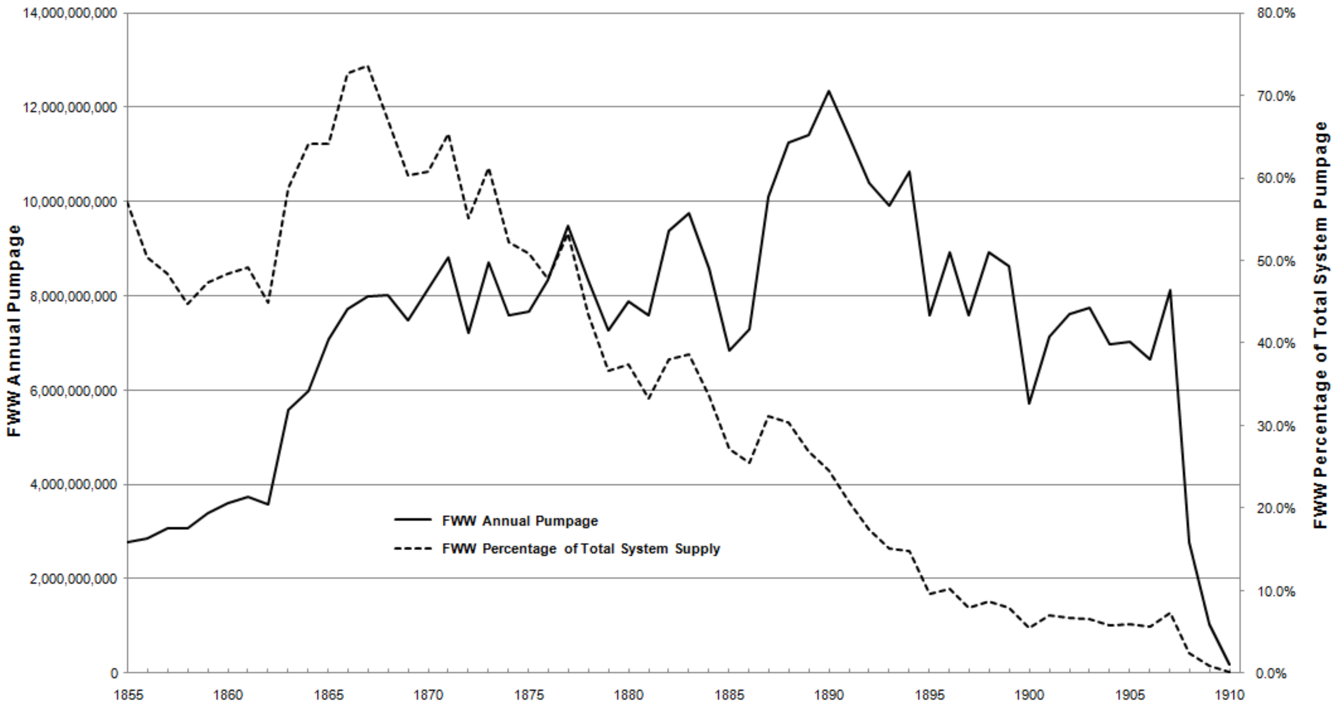
[391] Prosper Jean Auguste Maignen was a hydraulic engineer who was instrumental in the design of the City's filtration systems. He eventually held several patents for filtration systems. See for example P. J. A. Maignen, *System of Purifying Municipal Water Supplies, Patent No. 713896* (Washington, D.C.: U.S. Patent Office, 18 Nov 1902); P. J. A. Maignen, *Method of Washing Filter Sand, Patent No. 924682* (Washington, D.C.: U.S. Patent Office, 15 Jun 1909).

[392] P. J. A. Maignen, "The Problem of Water Purification for the City of Philadelphia," *Proceedings of the Engineer's Club of Philadelphia,* Vol. XVI, No. 2 (Philadelphia: Mar 1899), 84. This remark also serves to call attention to the fact that drawing "the whole flow of the river" does not mean that the Fairmount Pool was emptied, but that at least as much water was being taken out of it as flowed into it from upstream. As we have seen, at times no water flowed over the Fairmount Dam. Indeed, the water level was sometimes drawn down significantly below the top of the dam, a dangerous situation to be sure.

Fig. 7-1. Fairmount Water Works' Annual Pumpage and Percentage of Total System Supply, 1855–1910



Sources: Annual Reports from the Water Department (1855–1886) and Bureau of Water (1887–1910).

The same year, a three-member panel, headed by the highly respected hydraulic engineer Rudolph Hering, was commissioned by the City Councils at the urging of newly appointed Bureau of Water Chief Frank L. Hand.[393] The commission, whose members were chosen by Hand,[394] was tasked with making a comprehensive review of the city's water supply system and providing recommendations for next steps. Among other things, Hering's team recommended the filtration of the city's entire water supply, the drawing of all future increase in supply from the Delaware River, and the abandonment of Fairmount Reservoir.[395] Commenting specifically on the latter, Hering wrote:

[393] Bureau of Water, *Chief Engineer's 1899 Annual Report* (20 Jan 1900), xv.
[394] Hand-selected, as it were. See Bureau of Water, *Chief Engineer's 1899 Annual Report* (20 Jan 1900), xvi.
[395] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 75. This will be explored more fully in the next chapter.

> At Fairmount, the reservoir is too low for a proper service, being only 94 feet above tide. It is also inexpedient to filter the water at this station, and for these reasons we have recommended the abandonment of the Fairmount reservoir [*sic*].[396]

By 1900 enough reservoir capacity had been constructed that the Fairmount Reservoir represented just 1.9% of the total.[397] By the dawn of the twentieth century, Fairmount was hemmed in by high-visibility parkland on one side and dense development on the other. Constructing a filtration facility onsite or nearby would be difficult and expensive, and provide little benefit. From a cost-benefit standpoint, doing so made little sense.

In addition, recall that Turbines 1 and 3 pumped exclusively to the Fairmount Reservoir. If the reservoir was recommended for closure, then it necessarily followed that these two turbines would either be shut down or have their pumpage redirected to the East Park Reservoir like the other turbines at Fairmount.

In 1903 the Mayor, Director of the Department of Public Works, and the Chief Engineer of the Bureau of Water all agreed that the way forward had three components:[398]

1) Filtering the entire supply. (This did not include the Fairmount Water Works.)
2) Shifting the source of the supply from the Schuylkill River to the Delaware River for areas then served by the Fairmount, Corinthian Avenue, East Park, and Queen Lane Reservoirs. (The East Park and Queen Lane Reservoirs would continue to operate while the Fairmount and Corinthian Avenue Reservoirs would be abandoned.)
3) Using filtration plants at Roxborough and Torresdale to supply the remainder of

[396] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 79f.
[397] Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 29.
[398] Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), xxif, 46, 228.

the area east of the Schuylkill River not served by the East Park and Queen Lane Reservoirs.

Seeming to bolster this decision, the Center City area, which was supplied by the Fairmount Reservoir, saw a chronic water shortage in the first decade of the twentieth century. The turbines were often shut down due to low water and the overtaxed Spring Garden Station was unable to keep up with demand. With the quality of the water "deteriorating from year to year" and during freshets being "practically unfit for use," the combination was recognized as "unbearable."[399] "Many of the wealthier residents," Bureau Chief Hand reported in 1905, "threaten to move permanently to their country homes unless some improvement is effected."[400]

Making matters worse, April through December of 1908 saw the worst drought the city had experienced since the Fairmount Dam was completed in 1822. The water level of the Schuylkill River fell to one foot, four inches below the top of the dam and over three feet below the top of the flashboards. In order to alleviate the problem in Center City, additional connecting mains were laid so that the new Lardner's Point pumping station on the Delaware River could supply the area more reliably than Fairmount.[401]

By 1900 the Fairmount Water Works was contributing a tiny fraction of Philadelphia's water supply. Its turbines were extremely wasteful of water and could not be employed when they would have been most useful. The machinery was aging, increasingly costly to operate, and prone to catastrophic failure. The Fairmount Reservoir held a miniscule portion of the overall storage and supplied a shrinking area of the city.

Today one of the most common questions regarding the Fairmount Water Works is, Why

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[399] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 68.
[400] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 68.
[401] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 68; Bureau of Water, *Chief Engineer's 1906 Annual Report* (27 Jan 1907), 53; Bureau of Water, *Chief Engineer's 1908 Annual Report* (1 Jan 1909), 59.

was it shut down? At the turn of the twentieth century, however, the question that was increasingly being asked was, Why should the Fairmount Water Works be kept open?

CHAPTER 10

DISEASE, ART, AND THE END OF AN ERA

In a morbid preview of coming attractions, the typhoid death rate spiked in 1876 during the Centennial Exhibition.[1] The increase was caused in part by visiting outsiders but was nevertheless an indication of a growing problem. After the Centennial year, the mortality rate abated somewhat, but within a few years it was steadily high again, as shown in Figure 10-1. As one professional engineer described it, "…through lack of timely measures for effective purification, our city is now scourged by a visitation of typhoid fever more appalling in its death-rate than any experience of the past."[2]

As we have seen, a health crisis in the form of a series of yellow fever epidemics in the late eighteenth century was the primary driver behind the creation of the Fairmount Water Works. By the late nineteenth century another major health crisis—alarming rates of typhoid and, to a somewhat lesser extent, cholera—became an existential threat to its survival. Filtration, the one thing that was most effective at the time in combating typhoid and cholera, was difficult to incorporate at Fairmount. Even if a filtration system were constructed, Fairmount's machinery would soon have required a massive overhaul if not complete replacement and modernization. Costly either way.

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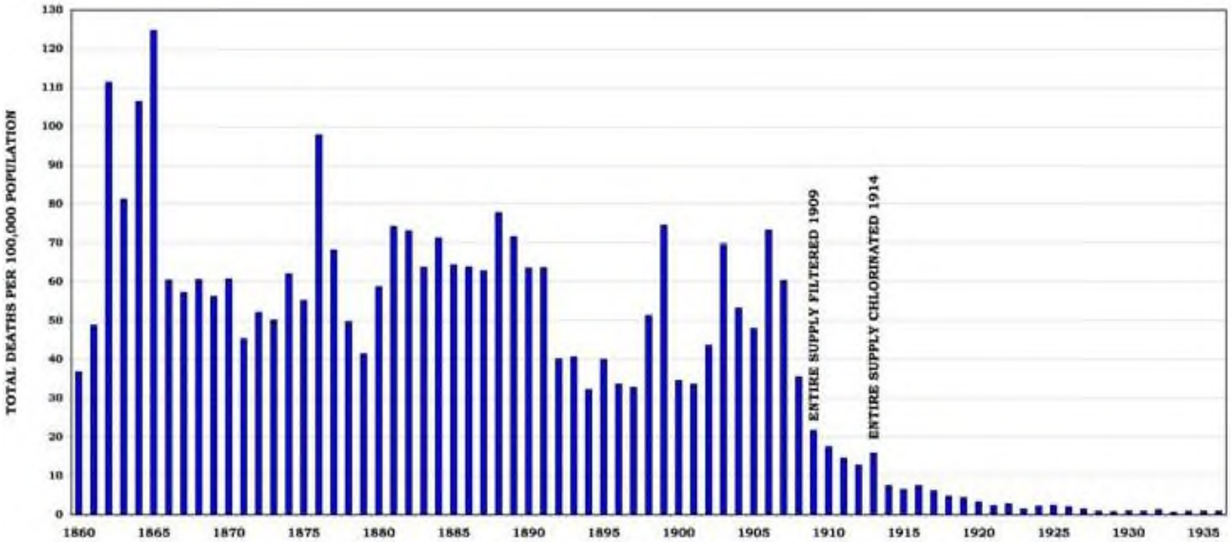
[1] Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), Fig. 1 at 113; C. Drew Brown et al., "Water and Drainage History Course, Module 6 (Philadelphia Water Department)," *Philly H_2O* (2015), table: "Mortality Rate from Typhoid Fever in Philadelphia, 1860–1936," <http://www.phillyh2o.org/canvas/canvas06.htm>, compiled by Adam Levine, Historical Consultant, Philadelphia Water Department, accessed 7 Sep 2022. See also Fig. 10-1 herein.

[2] Edgar Marburg, "The Water Problem in Philadelphia," *Proceedings of the Engineers' Club of Philadelphia,* Vol. XVI, No. 3 (Philadelphia, May 1899), 210.

Figure 10-1. Mortality Rate from Typhoid Fever in Philadelphia, 1860–1936.



Sources: Free Library of Philadelphia; Philadelphia Board of Health Annual Reports, 1860–1879; Philadelphia City Archives, Record Group 60.2; Mayor's Papers, "1937 Water" Folder; <phillyh20.org/canvas/canvas06.htm>. Compiled by Adam Levine, Historical Consultant, Philadelphia Water Department.

The Fairmount Water Works was increasingly being pummeled by a growing recognition of its wastefulness of water, aging machinery, diminished reliability, reduced share of the overall supply, and a reservoir with an ever-smaller service area, the station was effectively reduced to auxiliary status, its future weakened considerably. The additional difficulty and expense of building a filtration facility nearby was a right hook which left Fairmount reeling. This chapter is the story of that pummeling and right hook, along with the decisive uppercut that would knock the Fairmount Water Works to the canvas, never to arise.

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For its time, the Fairmount Water Works was highly effective—at pumping large amounts of raw Schuylkill River water into Philadelphia's distribution system. How healthy that water was, however, was a matter of debate. Observers began to note that increasing amounts of

residential and industrial waste were making their way into the Fairmount Pool. The water from the Schuylkill River was tainted and the problem was growing.

Concern over the cleanliness of the water was not new. In 1803, City Councils had passed a law providing for a fine of five dollars for anyone intentionally throwing any kind of filth into the river or canal, washing or bathing in the river, or causing an animal to go into the river.[3] In 1824, when the City of Philadelphia purchased all remaining water rights from the Schuylkill Navigation Company, it included a provision prohibiting the discharge of dyestuffs or other industrial wastes into the river immediately above the Fairmount Dam.[4] The Pennsylvania state legislature passed laws in 1828[5] and 1832[6] which were intended to protect the water in the Schuylkill River.

The 1832 legislation levied fines of between five and fifty dollars, at a judge's discretion, for anyone who "shall hereafter wilfully [*sic*] take, lead, conduct, carry off, or throw, or shall cause to be taken, led, conducted, carried off, or thrown into that part of the river Schuylkill which is between the dam at Flat Rock and the dam at Fair Mount, near the city of Philadelphia, any carrion or carcase [*sic*] of any dead horse or other animal, or any excrement or filth from any slaughter house, vault, well, sink, culvert, privy or necessary, or any offal or putrid or noxious matter from any dye house, still house, tan yard, or manufactory, or any matter or liquid

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[3] Lowber, *Ordinances of Philadelphia* (1812), 183, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 255, 302n.529.

[4] Joseph S. Lewis, Chairman of Watering Committee, to the Select and Common Councils (7 Apr 1824), 2, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 90, 302n.53.

[5] *Laws of Pennsylvania,* Session of 1827–1828, No. 138, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 256, 326n.30.

[6] *Laws of Pennsylvania,* Session of 1831–1832, No. 38, cited in Nelson Manfred Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956), 256, 326n.30.

calculated to render the water of said river impure."[7] Enforcement of these early legislative efforts, however, was never very energetic and manufacturers continued to pollute the river.

Sometimes City Councils themselves intentionally stymied effective enforcement. In his final annual report, Frederic Graff, Jr. wrote:

> In the early part of the year, the City Solicitor commenced proceedings against some of the mill owners at Manayunk to restrain them from all unnecessary discharge of foul matter into the Schuylkill; but Councils subsequently directed these proceedings to be suspended, and therefore the parties in question are still permitted (by the virtual sanction of Councils) to violate all the laws of justice and the common decencies of life by continuing to discharge foul matter into the river wantonly and unnecessarily. It is much to be regretted that the measures provided for such cases by the wisdom of the State Legislature should not be rigidly enforced.[8]

"Sedimentation," sometimes called "subsidence," was another solution that was tried, if only half-heartedly. After the raw water was pumped from the river, it was allowed to rest in a reservoir (or portion of one) before being drawn off into the distribution system. This was considered sufficient ever since Fairmount's inception in 1815. In theory the water would stay there long enough for a large portion of the foreign matter to settle out.[9] In practice, however, the water rarely stayed put long enough for this process to have much of an effect. In fact, during periods of high demand, "direct pumpage" often occurred.[10] At these times the water hardly rested at all; nearly as soon as it was pumped in one end of the reservoir it was pumped out the

[7] *Act of the Legislature of the State of Pennsylvania* (7 Jan 1832), quoted in *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 7f.
[8] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 15. One naturally wonders what type of complaint Graff, Jr., considered to be unreasonable at that time.
[9] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 14f.
[10] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 15.

other, directly into the water supply. Little or no sedimentation had a chance to take place.

This was recognized as a problem. In fact, one of the justifications for the completion of the controversial and long-delayed East Park Reservoir was that water could be pumped to it from the Fairmount Reservoir and other reservoirs so sedimentation could occur before the water was supplied to customers.[11] With typhoid and other disease rates becoming unacceptably high, however, it became increasingly recognized that sedimentation was no longer enough to ensure the safety of the city's water supply.

Creating parkland around the Schuylkill River was thought to have a salutary effect. As we have seen, when in 1843 the City purchased the Lemon Hill property, just upstream of the Fairmount Water Works, protecting the purity of the water was a large part of the motivation. As early as 1851, Frederic Graff, Jr., drew up plans for improving the area as a public park as far north as the Girard Avenue Bridge, even though the City didn't yet own all of the property. He advocated setting aside the area in order to prevent its use for industrial purposes. In 1855 the City created Fairmount Park by combining Lemon Hill with the grounds of the Fairmount Water Works. More land on both sides of the Schuylkill was added over the next twenty-some or so years, greatly enlarging the park; the Fairmount Park Commission was created in 1867 to manage and improve it. Graff himself served on the commission.

As the Schuylkill River became increasingly fouled, however, a growing number of officials came to understand that the city would eventually need to come to grips with the issue. How the City of Philadelphia arrived at, and implemented, a workable solution is an illustration of how decisions like these are never made nor implemented in a vacuum but within a larger context of the surrounding political and cultural climate.

[11] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 26.

Most of the city's water was drawn from the Schuylkill River, and as the river became increasingly polluted throughout the nineteenth century, scientists and ordinary people alike began to suspect that there was some connection between the use of dirty water for consumption and the rising incidence of diseases like typhoid and cholera.

Throughout most of the nineteenth century, the miasma and filth theories of disease were the predominant influences on what officials and the public both considered to be "clean" or "healthful" water. Because of this, water sources were evaluated macroscopically. Until about 1850, water was judged by the senses. How much foreign matter could be seen? How foul did it smell or taste? In the 1850s, water began to be evaluated for the amount of organic solids and vegetable matter. By the 1860s, the presence of certain elements and compounds like nitrogen and albuminoid ammonia began to be measured.[12]

From the 1830s[13] to the 1870s, scientists began to advance the germ theory of disease. This theory asserted that many diseases were caused by harmful, microscopic organisms called bacteria. Despite opposition, a growing body of evidence from observation and experimentation

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[12] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* (Baltimore: Johns Hopkins University Press, 2000), 84f, 110f, 136ff; Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 9ff.

[13] As early as 1837 and 1838, Theodore Schwann and Charles Cagniard-Latour (respectively) were the first to demonstrate that fermentation and putrefaction (respectively) were caused by microscopic living organisms. In 1840 Jakob Henle proposed that microorganisms were the contagions responsible for the spread of at least some infectious diseases. The scientific community of their day stood in opposition, however, and it was another generation before their ideas gained traction. See Theodore Schwann, "Vorläufige Mittheilung, Betreffend Versuche Über die Weingährung und Fäulnis [Preliminary Report on Experiments Concerning Alcoholic Fermentation and Putrefaction]," *Annalen der Physik und Chemie,* Vol. 41 (1837), 184ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 16ff; Charles Cagniard-Latour, "Mémoire sur la Fermentation Vineuse [Report On Alcoholic Fermentation]," *Annales de Chimie et de Physique,* Vol. 68 (1838), 206ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 20ff; Jakob Henle, "Von den Miasmen und Contagien und von den Miasmatisch-Contagiosen Krankheiten [Concerning Miasmatic, Contagious, and Miasmatic-Contagious Diseases]," *Pathologische Untersuchungen* (Berlin, 1840), 1ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 76ff.

by researchers like John Snow[14] and Joseph Lister[15] in Britain, Louis Pasteur[16] in France, and Robert Koch[17] in Germany finally led substantial numbers of scientists and public officials to accept the germ theory by the 1880s.[18]

According to the germ theory, it was neither the filth itself nor its stench that caused many diseases, but bacteria in the filth. Of course, it's true that bacteria are transmitted by contact with filth of various sorts (even by contact with droplets of moisture from a sneeze), and some types of "filth" are poisons in their own right, so between the three potential causes the correct one was difficult to distinguish. In effect, the miasma and filth theories muddied the waters of cause-and-effect until it could be shown convincingly that bacteria were the transmitting agents for many diseases. It's no wonder that the miasma and filth theories held on

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[14] Snow showed that cholera was spread by water contaminated by human fecal matter. See John Snow, *On the Mode of Communication of Cholera* (London: John Churchill, 1849, 1854).

[15] Lister demonstrated that wounds and surgical sites could be protected against infection by the use of antiseptics. See for example Joseph Lister, "On a New Method of Treating Compound Fracture, Abscess, Etc., With Observations on the Conditions of Suppuration," *Lancet*, Vol. 1 (1867), 326, 357, 387, 507; Vol. 2, 95, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 83ff; and Joseph Lister, "On the Antiseptic Principle in the Practice of Surgery," *British Medical Journal*, Vol. 2 (1867), 246, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 86ff.

[16] Pasteur demolished the concepts of spontaneous generation of life and the miasma theory of disease by proving once and for all that fermentation and putrefaction are caused by microscopic living organisms (microorganisms). See for example Louis Pasteur, "Mémoire sur la Fermentation Appelée Lactique (Extrait par l'Auteur) [Report on the Lactic Acid Fermentation (Author's Abstract)]," *Comptes Rendus de l'Académie des Sciences,* Vol. 45 (1857), 913ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 27ff; and Louis Pasteur, "Mémoire sur les Corpuscles Organisés qui Existent dans l'Atmosphère; Examen de la Doctrine des Générations Spontanées [Report on the Organized Bodies which Exist In the Atmosphere; Examination of the doctrine of Spontaneous Generation]," *Annales des Sciences Naturelles,* 4th series, Vol. 16 (1861) 5ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 43ff.

[17] Koch was the first to prove that certain specific diseases were caused by certain specific microorganisms. See for example Robert Koch, "Die Aetiologie der Milzbrand-Krankheit, Begründhet auf die Entwicklungsgeschichte des Bacilus Antracis [The Etiology of Anthrax, Based on the Life History of *Bacillus anthracis*]," *Beiträge zur Biologie der Pflanzen,* Vol. 2, No. 2 (1876), 277ff, excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 89ff; and Robert Koch, *Investigations Into the Etiology of Traumatic Infective Diseases,* trans. W. Watson Cheyne (London: The New Sydenham Society, 1880), excerpted and reproduced in Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 96ff.

[18] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: Johns Hopkins University Press, 2000), 55, 85, 111.

for so long.

Even when scientists began to suspect bacteria, the state of the art of microscopic instruments in the mid-nineteenth century made isolation of bacteria nearly impossible.[19] It is very difficult, even using the best conventional microscopes today, for example, to visually isolate a single *Salmonella enteric serotype typhi* bacillus or a single *Vibrio cholerae* bacterium in a sample of water tainted with fecal matter from a typhoid or cholera victim. It simply doesn't take very many of the wrong bacteria to sicken a person.

Because of the ascendance of the germ theory, by the mid-1880s "clean" or "healthy" water came to mean water which was free from bacteria, not just free from foreign matter or certain proteins.[20] But how could harmful bacteria be removed from the water supply?

As far back as the first quarter of the nineteenth century, engineers in Europe had begun to experiment with various types of filtration systems, some more effective than others. The experiments led to early operational systems in Scotland and elsewhere.[21] In Philadelphia, some began to publicly consider whether or not filtration should be used to remove suspended foreign material from the water supply.[22] New York Assistant Alderman Fyler Dibb commented in 1831 that the "citizens of Philadelphia are a contented people; they have the Schuylkill by their side;

[19] Thomas D. Brock, trans. and ed., *Milestones in Microbiology* (Washington, D.C.: American Society for Microbiology, 1999), 1.
[20] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: Johns Hopkins University Press, 2000), 110ff, 136ff. It wasn't until the 1920s that the concept of "pure" water, relatively free from organic or chemical contamination, began to emerge. In fact, public health officials and the public at large still today grapple with what "pure" means, wrestling with what level of this or that substance is acceptable to public health. See Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: Johns Hopkins University Press, 2000), 213ff.
[21] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* (Baltimore: Johns Hopkins University Press, 2000), 26f, 85f, 435n46. Operational filtration systems were completed in Paisley, Scotland, in 1804, Paris in 1807, Greenock, Scotland, in 1827, and London (the Chelsea Water Works) in 1829.
[22] Michal McMahon, "Makeshift Technology: Water and Politics in 19th-Century Philadelphia," *Environmental Review*, Vol. 12, No. 4 (Oxford University Press for Forest History Society and American Society for Environmental History, Winter 1988), 27.

and, from necessity, they improve it to the best advantage; but that water is not fit to drink without undergoing the process of filtration. I am informed, from indisputable authority, that insects may sometimes be seen in it one fourth of an inch in length."[23]After examining water from the Fairmount Water Works in 1846, engineer Frederick Erdmann declared that there was so much suspended foreign matter that it was "entirely unfit for use" and suggested filtration.[24] Those who could afford to do so took filtration into their own hands, purchasing and employing home filtering systems.

Frederick Graff was not in favor of filtration at Fairmount. In 1846, a year before his death, he had sent a handwritten note to the Watering Committee in response to a proposal:

> To the Gentlemen of the Watering Committee, Having carefully examined the proposition made to the City Councils to erect filtering apparatus [*sic*] in the Fair Mount Reservoirs capable of filtering 4,500,000 gallons per day, at a cost of $42,000[25] which was referred to me by the Watering Committee at their last meeting.
>
> I will briefly state that the Reservoirs at Fair Mount not having been adapted for the reception of filters many very great difficulties would occur in arranging them for that purpose.
>
> But even if the work could be accomplished without interference with the continued supply of water to the city, the quantity of water which the proposed filters will be capable of supplying would be entirely inadequate [*sic*] to the demand. By reference to the Report of the Watering Committee for 1845 it will be seen that the average consumption of water in the City and lower district from July 1 to Oct. 1 was 5,186,762 gallons per day, during that period

[23] *Remarks of Mr. Dibblee in Common Council,* 16, cited in Manfred Nelson Blake, *Water for the Cities* (Syracuse University Press, 1956), 258, 327n43.
[24] *Journal of the Select Council, 1845–1846,* Appendix, 106ff, cited in Manfred Nelson Blake, *Water for the Cities* (Syracuse University Press, 1956), 258f, 327n.44.
[25] The equivalent of approximately $1.6 million in 2022.

> upon some hot dry days upwards of 6,000,000 gallons per day were drawn off from the Reservoir.
>
> As this fact proves conclusively the insufficiency of the plan proposed I will not trouble the gentlemen at this time with the many serious objections to construction of any kind being placed in the reservoirs that cannot be control [*sic*] at all seasons of the year and which would so much endanger a constant supply of water to the city, the continuance of a supply of water such as the city has been blessed for the last 30 years without interruption.[26]

In all fairness to the elder Graff, the consensus at the time had been that the water from the Schuylkill River didn't need filtering. Tests in 1842 and 1845 of various types of solid matter found in the water showed it to be relatively clean.[27] After reviewing some of these results in 1852, the Watering Committee declared, "Any fears of the impurity of our supply, are entirely chimerical [imaginary]."[28]

Nevertheless, City Councils in 1853 directed the Watering Committee to "inquire into the practicability of erecting at Fairmount, a Filter of sufficient capacity to filter all the water used in the city, before it enters the distributing pipes."[29] The Committee hired two prominent chemists to conduct an analysis of the water in the Schuylkill River. They recorded that it contained 6.1 grains of foreign matter per gallon,[30] which compared favorably to previous investigations as well as to the sources of water for other cities. The scientists concluded,

> …we infer that the Schuylkill water has deteriorated, in no important respects, from its

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[26] *Journal of Select Council*, 1845–1846, Appendix, 108. Quoted in Manfred Nelson Blake, *Water for the Cities* (Syracuse University Press, 1956), 259.
[27] Watering Committee, *1852 Annual Report* (6 Jan 1853), 10f; James C. Booth and Thomas H. Garrett, *Report on Schuylkill Water* (23 Mar 1854), included in Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 16ff.
[28] Watering Committee, *1852 Annual Report* (6 Jan 1853), 11.
[29] Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 5.
[30] James C. Booth and Thomas H. Garrett, *Report on Schuylkill Water* (23 Mar 1854), included in Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 8, 18.

> former excellent quality; that from the nature of its small contents of mineral mater, and its unusual freedom from organic matter, it is superior to most waters for domestic and manufacturing purposes; that from the nature and quantity of its mineral contents, it is unnecessary to adopt a system of filtration to improve its quality; and lastly, a comparison of the past and present, leads to the inference, that no plan of improving the water will be required for many years to come.[31]

When the Schuylkill River was turbid after heavy rain, however, the scientists noted that it contained large amounts of fine clay silt which they believed would choke any filtration system which may be used. This pointed up the problem with large-scale filtration systems at the time. They were "cutting edge," as we would say today. Relatively new, those in use in Europe were slow and finicky. With diminished effectiveness in freezing temperatures, they were not entirely reliable year-round. They were also comparatively small and not nearly adequate for the volume of water being consumed by the citizens of Philadelphia. With all of that, they were costly to construct, maintain, and operate. It wasn't until the post-Civil War era that American engineers began to take seriously the various types of filtrations systems being developed and demonstrated in Europe.[32]

Frederic Graff, Jr. recommended against filtration in his annual report for 1854. Far from being airily dismissive, however, his report contained lengthy operational and cost-benefit analyses informed by the performance of experimental and operational systems in Europe. He calculated that the size of the filtration system, of the type then in use, would need to be over ten percent larger in area than the Fairmount Reservoir itself, even before taking into consideration

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[31] James C. Booth and Thomas H. Garrett, *Report on Schuylkill Water* (23 Mar 1854), included in Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 7f, 23f.
[32] Manfred Nelson Blake, *Water for the Cities* (Syracuse University Press, 1956), 260.

the need for excess capacity in order to allow for periodic cleaning of the filter beds. There was simply no room for such an installation at Fairmount.

Even if a system could be built at Fairmount, Graff, Jr. determined that it would be expensive to construct and maintain, and its effectiveness would be uncertain. As he put it in his report:

> I am fully convinced that no adequate result could be obtained from the enormous expense which it would be necessary to incur in building and keeping in order such large filter beds as we should require, and that probably the certainty of constant supply and efficiency of the works might be impaired by such troublesome and expensive, and I think, needless apparatus.[33]

In other words, believing he could not justify implementation because of filtration's cost and uncertainty, Graff, Jr. concluded that it was neither warranted nor feasible at the time.

The same year, in a special report on filtration, the Watering Committee proclaimed itself "perfectly satisfied with the extraordinary purity of the Schuylkill water."[34] What did it matter if a few insects and some solid matter were found in one's tap water from time to time? With tests in hand showing that water from the Schuylkill River had only 4½ percent of the foreign matter found in the water of a well in town, Birkinbine in 1859 declared it "remarkable for its purity."[35] The ongoing consensus was that filtering the water supply would be an enormous a waste of money and effort.

As time went on, however, the quality of the water seemed to get worse by the year. Despite the 1828 and 1832 state legislation penalizing anyone who knowingly polluted the

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[33] Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 14.
[34] Watering Committee, *Report of the Watering Committee…on Filtration* (Philadelphia: Crissy & Markley, 3 May 1854), 15.
[35] Water Department, *Chief Engineer's 1859 Annual Report* (9 Feb 1860), 44ff.

Schuylkill River, untreated industrial waste and commercial and residential sewage continued to be discharged into it. Never mind the comparison between well water and river water; the comparison worth noting was between what the Schuylkill River water had been and what it was becoming. By 1861, just two years after he found the river's purity "remarkable," Birkinbine included in his annual report for 1860 the first official recognition that waterborne pollution was compromising the quality of the water pumped by the Fairmount Water Works to residents of the city[36] and he wondered how effectively the City could push back against the manufacturing interests:

> How far it is necessary at present to interfere with the manufactories situated above this point, is a question which you can best decide. That the City has sufficient legislative power to compel all now draining into the dam to desist from the practice seems to be evident from the laws and agreements quoted above. But how far it would be wise to interfere with the large manufacturing interests which add so greatly to our permanent prosperity, is also a subject for your consideration. Much can be done, however, without putting manufacturers to large expense or great inconvenience. They might be prohibited from making the river a common sewer to carry off all refuse, and especially the discharge of privies, as is the practice in most of the factories.[37]

Four years later he was moved to write:

> A large amount of objectionable water is constantly flowing into Fairmount Dam—drainage from breweries, distilleries, gas, chemical, and dye works, paper, woolen and cotton mills, etc. Nor is this objectionable matter confined to drainage and liquid refuse, but spent dye stuff, lime, ashes, and all dross and waste material, no matter of what kind, are either thrown directly into the river, or so placed that the first freshet will carry them off and deposit

[36] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 7ff.
[37] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 18.

> them in the lower portion of the dam. Thus the river is not only made a common sewer, but general carrier of all objectionable and refuse matter.[38]

Birkinbine concluded at the time, “There appears to be ample legislation upon the subject, but these abuses have been so long continued, that the manufacturers and others look upon them as their rights.”[39]

In 1867, he observed in his final annual report as Chief Engineer:

> Within no equal period of time, has the amount of impurities drained into the Schuylkill increased to such an alarming extent as during the past year. This has been the result of the stimulation of manufactures, and the erecting of a number of new works in Manayunk and vicinity; such as paper-mills, oil refineries, &c.; all discharging their refuse into the dam, from which the water supplied to the City is taken.[40]

Birkinbine noted that the pollution was plainly visible for all to see:

> When the river is not turbid, the water flows over Flat Rock Dam, and among the rocks, limpid, bright, and beautiful as a mountain stream; but follow it down a few hundred yards, and after passing the paper-mills, the river, for one half its width, is of a dark-brown color. Further down, it receives the refuse from dye-works and manufactories of every kind, the entire sewage of Manayunk, and the refuse from the Gas Works.
>
> Below Manayunk, the river assumes a dark, dirty, milky appearance, and is covered with soiled waste and shreds from shoddy [reclaimed wool] mills; but by the time the water flows to the Falls, it assumes almost its original brilliancy; here, again, it receives more objectionable matter from the chemical and dye-works, but at the Columbia Bridge it seems to have deposited or destroyed all objectionable matter; and at Fairmount had apparently regained its original purity. But there is no doubt that a constant deterioration in quality is

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[38] Water Department, *Chief Engineer’s 1864 Annual Report* (2 Feb 1865), 7f.
[39] Water Department, *Chief Engineer’s 1864 Annual Report* (2 Feb 1865), 8.
[40] Water Department, *Chief Engineer’s 1866 Annual Report* (31 Jan 1867), 60.

> going on, which, if not arrested, will ultimately force the City to abandon the Schuylkill as a source of supply, if the time to do so has not already arrived.[41]

Birkinbine pointed out that tainted water was not simply a matter of preference or squeamishness; it was deadly serious. He pointed to records which showed that in London in 1853, only 37 individuals for every ten thousand had died from cholera in areas supplied with "better water," while in other areas the death rate was 130 for every ten thousand, over 3½ times greater.[42]

McFadden in 1875 indicated knowledge of a link between typhoid and tainted water. "Who can tell the misery incident to impure water, which was threatened last summer at Kensington," he wondered, "where putrescent fermentation set in, owing to sewage and the lack of freshets to scour the channels of the streams?"[43] McFadden quoted a published report by Dr. Stephen Smith, Health Commissioner of New York City, in which the commissioner asserted, "the causation of typhoid fever, though long enveloped in obscurity, is now well known; it is one of the so-called filth diseases of modern sanitary writers; its most ordinary exciting cause is the air, or drinking water befouled with excremental matter."[44] McFadden argued that a remedy should be applied as soon as possible.

Schuylkill River water, contaminated by increasing amounts of sewage, was indicted in 1875 as a contributing factor in the spread of cholera.[45] Reports by the Bureau of Water in the early 1880s noted that despite efforts by the board of health, large numbers of factories and

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[41] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 61f. Just upstream of Manayunk, the Flat Rock Dam is located approximately seven miles above the Fairmount Dam. Columbia Bridge is a railroad bridge (still extant) approximately 1½ miles above the Fairmount Dam.
[42] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 61.
[43] Water Department, *Chief Engineer's 1874 Annual Report,* (8 Apr 1875), 8.
[44] Water Department, *Chief Engineer's 1874 Annual Report,* (8 Apr 1875), 8.
[45] Charles M. Cresson, M.D., *Results of the Examination of Water from the River Schuylkill* (3 Mar 1875), included in Water Department, *Chief Engineer's 1874 Annual Report* (Philadelphia, 8 Apr 1875), 32ff.

homes, multiple taverns, and even a police station were draining their toilets either directly into the river or into sewers which drained into the river.[46] In 1884, Ludlow, in his first annual report after being appointed Chief Engineer, called the Schuylkill River a "natural sewer"[47] into which collected "sewage, chemicals, wool-washings, dye stuffs, [and] butcher and brewery refuse."[48]

In 1883 and 1884, the Water Department conducted an investigation into the quality of the city's water supply. Chief Engineer William Ludlow summarized the Department's findings:

> It was shown that apart from the general impairment of quality due to the large and increasing population and industries of the valley using the river as a conduit for waste matters of every sort, the grossest and most obvious contaminations—and, from their propinquity [nearness, proximity], the most dangerous, also—were occurring within the city limits, and in the Fairmount Pool itself, under the very eyes and noses of the public.
>
> It was further shown that among the most objectionable and obtrusive of all were public sewers, with which the neighboring mills, breweries and domiciles had been either permitted or required to connect. In other words, that the great receiving basin of the city—to wit, the Fairmount Pool, whence 80 percent of the entire supply is taken—was used in effect as a general cesspool for the riddance of the foulest and most deleterious waste matters; and that the city itself by permitting and participating in this violation of law and decency had in effect constituted itself the chief sinner.[49]

A year later, Ludlow cited a long historical litany—page after page—of increasingly objectionable conditions,[50] a veritable "pollution's greatest hits," before concluding:

> This brief résumé of the history of the Schuylkill supply, derived exclusively from the

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[46] Bureau of Water, *Documents related to the pollution of the Schuylkill River* (1893), 36ff. This document is actually a collection of reports.
[47] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 46.
[48] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 46.
[49] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 38.
[50] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 40ff.

> official published reports of the Water Department, and without reference to the considerable body of current literature on the subject, consisting of newspaper and magazine article, reports and discussions in medical journals, private publications and other sources, is given in order that some conception may be formed of the gradual deterioration of the stream and its increasing inability to fulfill the legitimate requirements of a water supply for the city.[51]

Throughout the second half of the nineteenth century, the increasingly polluted raw river water that was being pumped into the homes and businesses of the citizens of Philadelphia was increasingly making them sick.

It took until 1909, nearly fifty years after the problem began to be recognized, to fully implement an effective solution. Why so long? It was a combination of uncertainty regarding which solution or combination of solutions should be implemented, and political obstinacy.

In the meantime, people were continuing to sicken and die.

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There were two general categories of solutions to the water contamination problem: bring in cleaner water from elsewhere or clean the water on hand. The second category further broke out into two sub-options: clean the water in the river or clean the water after it was pumped out of the river.[52] These last two options, of course, were not mutually exclusive. Philadelphia's leaders were faced with a decision more complex than simply finding and implementing a single, silver-bullet solution. Perhaps the city should employ a combination of solutions. In hindsight the answers seem rather obvious, but that was not at all the case at the time. It never is.

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[51] Water Department, *Chief Engineer's 1884 Annual Report* (1 Apr 1885), 53f.
[52] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* (Baltimore: Johns Hopkins University Press, 2000), 80.

The first solution to the polluted water problem to be addressed was that of bringing in water from elsewhere. That meant an aqueduct of some sort. In the summer of 1883, City Council asked nationally respected civil engineer Rudolph Hering to survey various aqueduct sources and schemes. In 1886, after a three-year investigation, he recommended an aqueduct from the upper Delaware River at Point Pleasant in rural Bucks County. At up to $20 million[53] the cost would be daunting, however, and Hering could not guarantee a significant increase in water quality over time.[54]

To determine the extent of the pollution problem, City Council in the spring of 1885 appointed a team of chemistry professors, led by J. W. Mallet of the University of Virginia, to conduct a quality survey of the city's water supply. The team sampled water at various pumping stations and compared the water with that of other cities. Reporting directly to City Council instead of the Water Department, the group deemed the quality of the water to be not as good as some but better than others.[55] Based on the report, the City Council's water committee decided that quality concerns were "exaggerated."[56]

One of the survey team's participants, Professor Albert R. Leeds of the Stevens Institute in New Jersey, criticized the team's methodology, however, objecting particularly to its small sample size. He identified the water collected from various points as ranging from "good" to "doubtful" to "unfit for use." Professor Leeds declared the team's cheerful report unwarranted.[57]

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[53] The equivalent of approximately $630 million in 2022.
[54] Rudolph Hering, "Final Report: Surveys for the Future Water Supply of the City of Philadelphia," *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 267ff. esp. 308ff.
[55] Report included in Board of Health, *Annual Report* (1885) and Bureau of Water, *1885 Annual Report* (1 Apr 1886), 66ff. See Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 55ff for Chief Engineer Ludlow's comments on the report.
[56] *Journal of the Select Council*, Appendix No. 88 (6 Apr 1885–25 Sep 1885), 134; cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 11f.
[57] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 12f.

Another critic of the survey was Dr. Charles Cresson, a physician and chemist on the city's Board of Health. Ten years earlier Cresson had initiated testing of Philadelphia's water for nitrogen and albuminoid ammonia. Water from all of the sources Cresson sampled had tested at the "unfit" level. He considered Philadelphia's water supply to be dangerous.[58]

Ludlow too thought the Mallet report was flawed—and far from reassuring. He pointed out that that the investigators began their analysis by filtering out all of the solid material found in the water. [59] Despite this, he recommended against filtration, believing it to be unaffordable and impractical at the time. Instead he suggested waiting to see what the effect of increased sedimentation would be once the East Park Reservoir and other improvements were completed. "Until these and other important expenditures…shall have been made," Ludlow thought, "provision for filtering appliances is out of the question."[60]

At about this time, however, an incident occurred which pointed up the connection between contaminated water and the spread of typhoid, illustrating in sharp relief the precarious nature of the methods being used to protect public health. It took place in Plymouth, Pennsylvania, a small town along the East Branch of the Susquehanna River about two miles downstream of Wilkes-Barre. In the spring of 1885 a typhoid epidemic swept through the town and sickened nearly 1,200 of the 8,000 residents, or approximately 15 per cent of the population. By the time the epidemic waned, 114, or a little over one percent, had died.

Probably because of the rising typhoid problem in Philadelphia at the time, Mayor William B. Smith commissioned a pair of doctors to investigate the cause and report back. M. S. French, M.D., a surgeon with the Philadelphia Police Department, and E. O. Shakespeare, M.D,

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[58] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 13.
[59] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 55ff.
[60] Water Department, *Chief Engineer's 1885 Annual Report* (1 Apr 1886), 50.

a pathologist and ophthalmic surgeon at Philadelphia Hospital and president of the Pathological Society of Philadelphia, wasted no time in visited the town and conducting an investigation. They submitted their report to Mayor Smith on 12 May 1885.

The two doctors determined that the entire epidemic was caused by a single person. A man living above the town had been sick with typhoid from January through April. His dwelling was located on a slope within 80 feet of a mountain stream (today called Coal Creek) which was the major source of the town's water. At night, his nurses were in the habit of emptying his bedpan by walking outside and pitching the contents onto the ground toward the stream. During the day his nurses would empty his bedpan in an outhouse which had no privy pit beneath it but merely discharged onto the sloping ground. From January through March, the ground was completely frozen and often snow-covered. On 25 March a thaw began. By 2 April there had been considerable rainfall. In the words of the report, "a large part, if not indeed the whole, of that portion of the three months' accumulation of the intestinal matter which had been carried out in the night and thrown towards the stream, was no doubt suddenly washed into the brook not sixty feet distant. … About the time of this thaw, and a little before it, the patient had numerous and copious hemorrhages from the bowels, usually in the night."[61]

Since freezing does not kill the *Salmonella typhi* bacterium which causes typhoid, it wasn't long before Plymouth's water supply was contaminated. By 10 April, residents of the town were being sickened in large numbers and deaths followed, with all the suffering and pathos attendant in such circumstances. In some families, four and five members were sickened. In one, pre-teen children were attempting to tend to their sick parents. In another, three sick children whose parents had been killed were being cared for by a neighbor. In some homes, the

[61] French, M. S., MD, and E. O. Shakespeare, MD. *Report Upon the Epidemic of Typhoid Fever at Plymouth, Luzerne County, Pa.* (Philadelphia, 11 May 1885), 11f.

sick were in one room while the dead were in the next room awaiting burial. The local school house was converted into a temporary hospital, supplied with beds and equipment by the hospital in Wilkes-Barre. Over a hundred families were left destitute. Surrounding villages tried to help as best they could.

Decrying the "pall of death"[62] they found, the Philadelphia doctors remarked,

> It is very well to look to purity of the water supply after the epidemic has originated and spread. Had that matter been attended to for the town of Plymouth six months ago by some competent person armed with the power of the State to protect the lives of her citizens, the fearful sacrifice of life, health and material interests which that unfortunate town has already made, and must still make, because of a negligence which, had it been designed, would have been nothing short of criminality, would not have happened. In the name of humanity, let the State speedily clothe some one [*sic*] with the power to protect communities against the penalties of infraction, whether through carelessness or ignorance, of the plainest sanitary laws.[63]

If water contaminated with infected fecal matter from a single typhoid sufferer could cause such a monstrous problem, the implications for a city like Philadelphia were ominous. Raw sewage continued to be discharged into the Schuylkill River, the major source of the city's water supply. It was a major health crisis waiting to happen, the proverbial ticking time-bomb.

The City Councils didn't immediately address Rudolph Hering's 1883 aqueduct report, but in the late 1880s and early 1890s it did fund the construction of two things which began to have at least some positive effect on the problem of contaminated Schuylkill River water:

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[62] French, M. S., MD, and E. O. Shakespeare, MD. *Report Upon the Epidemic of Typhoid Fever at Plymouth, Luzerne County, Pa.* (Philadelphia, 11 May 1885), 14.
[63] French, M. S., MD, and E. O. Shakespeare, MD. *Report Upon the Epidemic of Typhoid Fever at Plymouth, Luzerne County, Pa.* (Philadelphia, 11 May 1885), 14.

interceptor sewers and larger reservoirs for sedimentation.[64]

An interceptor sewer was constructed on the east bank of the Schuylkill River from Manayunk to just below Fairmount. Another was built along the Wissahickon Creek. Together they caught residential and commercial sewage and storm water runoff from the Manayunk, lower Roxborough, and East Falls neighborhoods. Instead of allowing it to be discharged into the river upstream of water intakes at Roxborough, Belmont, and Fairmount, the sewage was carried to a point just below the Fairmount Water Works.[65]

The construction of three large reservoirs was funded, the East Park Reservoir and two additional reservoirs at Roxborough. Water pumped into these reservoirs would employ sedimentation as the only treatment before sending the water into the distribution system.

In 1888 Emile Geyelin weighed in on the water quality issue. In a locally published article, titled *How to Get Good Water*, he characterized the interceptor sewer along the east side of the Schuylkill River above Fairmount as a good start but too small. He proposed adding 30-inch interceptor sewers on both sides of the river at Bridgeport, Norristown, Conshohocken, and Manayunk, leading to sewage collection plants at Norristown and Manayunk. He estimated the system would cost $700,000 to build[66] and $15,000 per year to operate.[67]

On the water supply side, Geyelin proposed filtration plants at the Spring Garden Works, at the Belmont Works, and at Fairmount. He estimated a $400,000 construction cost[68] $24,000 in annual operating expenses.[69] Geyelin thought a system like this would be far more cost-effective

[64] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 14f.
[65] Water Department, *Chief Engineer's 1886 Annual Report* (1 Feb 1887), 31f; Water Department, *Chief Engineer's 1888 Annual Report* (23 Jan 1889), 124.
[66] The equivalent of approximately $21.8 million in 2022.
[67] The equivalent of approximately $467,600 in 2022.
[68] The equivalent of approximately $12.5 million in 2022.
[69] The equivalent of approximately $748,200 in 2022.

than the Delaware River aqueduct scheme being considered at the time, which he believed would end up costing at least $7.5 million[70] and take far too long to build.[71]

In other words, Geyelin proposed keeping sewage out of the river and filtering the water drawn out of it. At its most basic, this is what all water systems do today. In Philadelphia, at least, Emile Geyelin was the first to put it all together in a single, comprehensive proposal.

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During this time it was thought by many that as water flowed down a river, natural aeration would serve to purify it. For some it was an excuse for standing pat.[72] In 1889 local doctor Henry Hartshorne demolished the concept, at least in regard to the Schuylkill River, when he published *Our Water Supply: What It Is and What It Should Be.*[73] Included in the physician's pamphlet was a detailed survey of revolting commercial and residential sewage pollution from sources such as residences, factories, slaughterhouses, and stables in Schuylkill River communities above Philadelphia.[74] Interceptor sewers provided no protection from wastes entering upstream of the city. "Think of it," he implored, "drink of it then, if you can."[75]

Dr. Hartshorne asserted that the distance along the Schuylkill River from the sources of

[70] The equivalent of approximately $234 million in 2022.
[71] "How to Get Good Water," *Philadelphia Inquirer* (2 Oct 1888), 2. Geyelin also proposed a controlling authority be created by the Pennsylvania legislature to oversee the Schuylkill River from Reading to its mouth on the Delaware River and enforce existing anti-pollution laws.
[72] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 16.
[73] *Our Water Supply, The Way to Improve It: Proceedings of a Committee of Citizens of Germantown, Philadelphia* (Philadelphia, 1889).
[74] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 16.
[75] Henry Hartshorne, M.D., *Our Water Supply: What It Is and What It Should Be* (1889), 17f, quoted in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 16.

pollution was not nearly long enough to provide for effective cleansing by aeration and recommended filters be constructed. He pointed to the example of London where various filtration facilities reduced microbes in raw Thames River water between 86 and 98 percent, depending on the type of filtration system and its location along the river.[76] This was the first time in Philadelphia that filtration received full-throated recommendation by a professional.[77]

But filters were just beginning to be recognized as a viable solution to the problem of contaminated water and the solutions already in place on the Schuylkill River—interceptor sewers and sedimentation reservoirs—seemed to be having a positive effect. When the annual mortality rate (deaths per 100,000 population) dropped to 40.1 (440 total deaths) in 1892 after temporarily spiking to 77.8 (785 total deaths) in 1888,[78] the sense of urgency waned. Implementation of large-scale filtration was not perceived as immediately important at the time.[79]

When a serious cholera outbreak in Germany, however, threatened an appearance on American shores in 1892,[80] City Councils did decide to dip its toe into the filtration waters and approved construction of an experimental filtration facility on the Schuylkill River but the threat

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[76] Henry Hartshorne, M.D., *Our Water Supply: What It Is and What It Should Be* (1889), 23f, cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 16f.

[77] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 16.

[78] *Philadelphia City Archives,* Record Group 60.2.

[79] A fairly detailed discussion of the struggle to implement filtration of Philadelphia's water supply is recounted in the present work because it had a direct effect on the timing and rationale for the closing of the Fairmount Water Works as a water pumping facility. For a description of the political machinations leading to the virtual elimination of typhoid (and cholera) as a public health problem in Philadelphia, the author-editor is indebted to Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987).

[80] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* (Baltimore: Johns Hopkins University Press, 2000), 141; Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 25f.

passed before Councils got around to appropriating funds for it and it was never built.[81]

By this time, the germ theory of disease had gained wide acceptance. In 1894 Dr. William H. Ford, chairing a Board of Health committee, urged the creation within the health department of a bacteriological division, similar to what had recently been done in New York City. The Board concurred and requested from City Councils $15,000[82] for a bacteriologist, support staff, and expenses. The lab opened in City Hall, fully funded, in 1895. The goal of the lab was to come to grips not just with typhoid but also with diphtheria, scarlet fever, smallpox, German measles (today called rubella), meningitis, tuberculosis, and others.[83]

In October of 1894 Republican reformer Charles F. Warwick, promising to reduce corruption in city government, was elected mayor, beating Boise Penrose, the machine politician.[84] Under the terms of the city charter, though, Warwick didn't take office until the following April. In the meantime, medical doctor and Massachusetts Institute of Technology professor of chemistry Thomas M. Drown[85] delivered a broadly publicized[86] lecture in town on the experimental filtration station on the Merrimac River at Lawrence, Massachusetts.[87] As a consulting chemist to the Massachusetts State Board of Health, he headed the Lawrence facility.

Like Philadelphia, Lawrence had a problem with upstream sewage polluting its water

[81] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 27f.
[82] The equivalent of approximately $516,600 in 2022.
[83] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 28f.
[84] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 297f; Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 18ff.
[85] Native Philadelphian Drown was would go on to become president of Lehigh University, as well as president of the American Institute of Mining Engineers. See "Obituary: Dr. Thomas M. Drown," *The Harvard Crimson* (21 Nov 1904), <www.thecrimson.com/article/1904/11/21/obituary-pdr-thomas-m-drown-president>, accessed 7 Sep 2022.
[86] *Public Ledger* (15 Jan 1896); *Philadelphia Press* (15 Jan 1896); cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 22.
[87] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 22ff.

supply. Also like Philadelphia, it had a deadly typhoid rate, in its case four times higher than the average across Massachusetts. Slow sand filters used at the experimental station cut the typhoid rate dramatically. Drown described the relationship between the use of the filters and the decline in the typhoid rate as direct "cause and effect," stating that after Lawrence's example Philadelphia could no longer be justified in delaying implementation of effective measures. He declared that Philadelphia had three options for improving its water quality:[88]

1. Abandon the current water supply and obtain a cleaner one. (As we have seen, this meant aqueducts to carry water in from further upstream or from other watersheds.)
2. Clean the current water supply by removing the pollution at its source. (The interceptor sewers helped with this but did not eliminate the problem.)
3. Clean the current water supply by using sand filtration to purify it after it is drawn from the river.

Drown emphatically recommended the third option.[89]

Soon after Charles Warwick took office he appointed Trautwine Chief Engineer of the Bureau of Water.[90] Instead of filtration, curiously, Trautwine made his first priority curbing the "reckless waste of water."[91] He wasn't against filtration as a solution to the typhoid problem. On the contrary, he desired it very much. He saw water waste, however, as one of the chief impediments to the implementation of filtration. The increase in demand was outstripping the increase in reservoir capacity. Philadelphia, he was concerned, might never be able to afford all

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[88] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 23f.
[89] *Philadelphia Press* (15 Jan 1896); cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 24.
[90] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 29.
[91] Bureau of Water, *Chief Engineer's 1895 Annual Report* (Philadelphia, 6 Apr 1896), 99.

the filtration systems necessary for the climbing consumption of water which he believed was due in large part to waste by heedless consumers. Trautwine believed that money wasted pumping unnecessary water could go instead toward building filtration plants. As a solution he proposed mandatory residential and commercial metering.[92] He saw it as the key to establishing filtration and called for implementation of metering before attempted implementation of filtration.[93]

The Water Bureau might have been able to at least partially fund filtration systems from the surplus funds it generated were it not for two factors that were a result of boss control of the political process in Philadelphia at the time. The cost of virtually all city services and projects, across the City government, was artificially increased because contracts would go to favored individuals who could be counted on to kick back a percentage to the political machine. In other words, the Water Bureau was getting far less for its money than it should have, even before it had to pay for water waste. Moreover, the surplus funds the agency generated had always been raked off into the City's general fund, since long before the rise of machine politics, forcing it to make special funding requests to City Councils whenever it needed to expand its system or upgrade facilities.[94]

Trautwine was most likely right about rampant waste of water. Spot checks in 1895 suggested over 80 percent of residential water consumption was wasted, due mostly to such

[92] As early as 1869, Frederic Graff, Jr., had recommended meters to control wasting of water. Even then, Philadelphia was the only large American city without them. Graff, though, would have employed meters only for large customers—factories, breweries, distilleries, hotels, and the like—for whom reliable assessment of water usage was difficult. See Water Department, *Chief Engineer's 1868 Annual Report* (Feb 1869), 15.
[93] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 30f.
[94] Russell F. Weigley, ed., *Philadelphia: A 300-Year History* (New York: W. W. Norton & Co., 1982), 539 (see 546 for example).

things as leaking faucets and continuously running toilets.[95] This was especially vexing since approximately 90 percent of the city's water consumption was residential.[96]

In addition, there was a connection between water waste and the typhoid crisis beyond the issue of the high cost of filtering wasted water. High demand meant a greater chance that direct pumpage would occur, negating what little effect sedimentation might have had on the cleanliness of the water,[97]

Why was there so much wasting of water? Recall that at the time a home's monthly water bill was not determined by how much water was actually used, but by the number of water fixtures or "appliances" were present. A certain amount was charged for each kitchen faucet, say, or toilet, sanitary sink, exterior spigot, and so on. The monthly bill was called a "water rent." With this system the homeowner had little incentive to fix leaky faucets or running toilets since no matter how much water was used or wasted, the water rent remained the same. With a water *rate* system, by contrast, the consumer is charged a certain amount per gallon of water consumed. Under such an arrangement there is a powerful financial incentive on the part of the consumer to repair faulty devices because it lowers the water bill. But a water rate system requires metering.

The public, however, was overwhelmingly against metering. Some asserted the poor would suffer the most by bearing a higher cost as a percentage of income. Others claimed that in an attempt to save money, the poor would reduce the use of water to the point of being

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[95] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 30f.
[96] Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 99.
[97] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 77.

unsanitary.[98] Many simply thought they had a right to an unlimited supply of free water.[99] City Councils were in no mood to force the issue.[100] Because of public resistance, ironically, Trautwine's stance on metering probably delayed the implementation of filtration systems.[101]

When Philadelphia was ready for filtration, however, Trautwine wanted to be prepared with the best type to recommend, tailored to the needs of the community. During his first year as chief of the Bureau of Water, Trautwine requested $250,000[102] for an experimental filtration station for the testing of various types of filter systems.[103] One of the complicating factors with filtration is that there was more than one type, slow sand filters and rapid (sometimes called "mechanical") sand filters. Proponents of both types argued the relative merits of each. The better choice in any given circumstance was heavily affected by such things as the amount of land which could be devoted to a filtration system and the level of demand. It was not always clear which type was best suited to the needs of a particular location. Complicating the situation further, while the concept of filtration wasn't exactly brand-new, the technology was still subject to the kind of change that can quickly make things obsolete.[104]

In early 1896, City Councils' joint finance and water committees approved Trautwine's entire request and moved a bill out of committee, but on 5 March Common Councilman Thomas

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[98] "The Water-Supply of Cities," *North American Review,* Vol. 136 (Apr 1883), 373; cited in Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* (Baltimore: Johns Hopkins University Press, 2000), 124.
[99] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 32.
[100] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 32.
[101] Indeed, pushing for metering at this time was quixotic at best. As it turns out, Philadelphia did not implement compulsory water metering until 1919, 24 years after Trautwine was appointed the head of the Water Bureau.
[102] The equivalent of approximately $8.9 million in 2022.
[103] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 32.
[104] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 32f.

Meehan challenged the bill.[105] Other councilmen lined up to oppose the bill, following Meehan's lead. They questioned professional expertise and appealed to so-called common sense.[106] The filtration effort came to a halt.

More than a councilman, Thomas Meehan (21 Mar 1826–19 Nov 1901)[107] was a highly respected botanist, nurseryman, writer, and editor. Born in England, he spent his childhood among estate gardens his father managed on the Isle of Wight. After completing his studies at London's Royal Gardens at Kew, he emigrated to the United States at age 22 and, after working at various estates, including Bartram's Garden,[108] settled in the Germantown neighborhood of Philadelphia. He established a nursery in Germantown in 1853 which grew into one of the premiere businesses of its kind in the country. Specializing in trees and shrubs native to America, it shipped throughout the country and around the world.

Meehan published numerous scientific papers, the first when he was twelve years old. He wrote *Wayside Flowers, The American Handbook of Ornamental Trees,* and the four-volume *The Flowers and Ferns of the United States.* He edited the popular horticultural magazines *Gardener's Monthly* from 1859 to 1889 and *Meehans' Monthly* from 1891 until his death. He

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105 Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 33.
106 Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 34.
107 Gertrude Jekyll & E. T. Cook, eds., *The Garden,* Vol. LIX (London, 22 Jun 1901), 446; Liberty Hyde Bailey, ed., *Cyclopedia of American Agriculture,* Vol. IV (London: Macmillan & Co., 1909), 505f; Edwin C. Jellett, *Germantown Gardens and Gardeners* (Germantown, Philadelphia: Horace P. McCann, 1914), 53ff; William J. Campbell, *Germantown History* (Germantown, Philadelphia: Germantown Historical Society, 1915), 303ff; Stephanie Ginsberg Oberle, *The Influence of Thomas Meehan on Horticulture in the United States* (University of Delaware, 1997).
108 Meehan later led a successful effort to save Bartram's Garden from development when ownership of the estate changed hands. See William J. Campbell, *Germantown History* (Germantown, Philadelphia: Germantown Historical Society, 1915), 305; Thomas Meehan, ed., *Meehans' Monthly: A Magazine of Horticulture, Botany, and Kindred Subjects* (Mar 1897), cited in Stephanie Ginsberg Oberle, *The Influence of Thomas Meehan on Horticulture in the United States* (University of Delaware, 1997), 57ff, 60n10; Charles S. Sargent, ed., *Garden and Forest: A Journal of Horticulture, Landscape Art, and Forestry* (New York: 27 Mar 1889), 156, cited in Stephanie Ginsberg Oberle, *The Influence of Thomas Meehan on Horticulture in the United States* (University of Delaware, 1997), 57ff, 60n13.

was the agricultural or horticultural editor or contributor to over a half dozen weekly and monthly newspapers and periodicals. For many years he was the horticultural editor of the *Philadelphia Press,* for example, and for thirty years the regular scientific editorial contributor to the New York Independent.

An early Fellow of the American Association for the Advancement of Science, Meehan was also an active member of the American Philosophical Society, the Pennsylvania Horticultural Society, and the Pennsylvania Agricultural Society, and was a founding member of the Pennsylvania Botanical Society. He served as senior vice president of the Academy of Natural Sciences in Philadelphia for 23 years. A few months before his death, he was awarded the prestigious Veitch Memorial Medal for his contributions to the science of horticulture, only the third American to be so honored at the time.

First elected to the Common Council in 1882, and serving until his death, Meehan inaugurated a movement for the establishment of numerous small parks across Philadelphia. As a longtime member of the Germantown school board, he helped introduce kindergarten to the city and was instrumental in the founding of seven new schools, including two exclusively for black teachers and students. After the governor of Pennsylvania appointed him "State Botanist" he helped create the Pennsylvania Department of Forestry.

Meehan suffered from hearing loss late in life. When the Academy of Natural Sciences offered him the position of president in 1891, he declined because of his deafness.[109] Despite his poor hearing, at 70 years of age Meehan was an influential "elder statesman." Strong in his opinions, he was charming and persuasive.

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[109] Edwin C. Jellett, *Germantown Gardens and Gardeners* (Germantown, Philadelphia: Horace P. McCann, 1914), 54; Harry G. Lang and Jorge A. Santiago-Blay, "Contributions of Deaf People to Entomology: A Hidden Legacy," *Terrestrial Arthropod Reviews,* Vol. 5, Issues 3–4, (Brill, 1 Jan 2012), 223ff.

One would not have expected Meehan to oppose filtration. As a man of science—if largely an autodidact—Meehan might have been expected to enthusiastically support it. Philosophically, however, he found the germ theory of disease difficult to accept, asserting that scientists recognized many bacteria as harmless and some even beneficial. As a Unitarian, his view of a rational world did not include the possibility of micro-organisms that could be so harmful as to cause such human misery.[110] He wasn't alone in his skepticism, but he was certainly in a position to leverage it. He also had a plain lack of faith in the efficacy of filters. Grudgingly accepting that some bacteria may be dangerous, and noting that even the best of filters didn't remove all of them, Meehan held that filters simply didn't work. He favored continued reliance on sedimentation. There was also the factor of ward politics. Meehan was focused on his own constituents. The experimental station would only benefit a relatively small portion of the city and that portion did not include Meehan's ward in the Germantown neighborhood.

Five days later, Trautwine answered Meehan and his allies in the press. He mustered data and information from experts and cited examples from other cities. Much of his response was directed at misconceptions of filtration and what he considered to be benighted views on bacteria.[111] Far from having the desired effect, however, Trautwine's very public retort only served to heighten tensions and harden positions.[112] For Meehan, the injudicious rejoinder made him angry and intransigent.[113] On 12 and 19 Mar 1896, opponents of the bill filibustered for two

[110] "Last Honors to Thomas Meehan," *Philadelphia Inquirer* (23 Nov 1901), 8.
[111] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 35
[112] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 39
[113] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 36f, 38f.

entire days.[114]

Late on the nineteenth, supporters in Common Council forced a vote which came up 49–37 in favor, but less than the two thirds majority necessary for approval of appropriation (funding) bills. Seeing that, Select Council didn't bother to bring the bill up for a vote.[115]

Why such opposition from others besides Meehan? One reason was petty politics. Recall that Mayor Warwick was elected as a reformer, an outsider. He won the election over Boise Penrose, the machine candidate. Penrose supporters and others of the political establishment began to cause the mayor trouble behind the scenes shortly after the election. Filtration was being proposed by Trautwine, a Warwick appointee. Councilman Meehan was neither a supporter of Penrose, nor a typical machine politician, but many of the filtration bill's other opponents were both and they were vocal. The filtration bill was an opportunity for machine politicians to demonstrate their strength and embarrass the mayor.[116]

Still other councilmen, in contrast, were supportive of filtration. Some even voted against the current bill because they favored a direct move to full city-wide filtration and opposed anything less.[117]

Many in the public and the press were angry themselves. Business leaders created the City Organizations' Filtration Committee to agitate for funding of filtration. Those from Germantown formed the core of the organization but it attracted a base of membership from

[114] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 36.
[115] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 37.
[116] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 18ff, 37.
[117] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 39f.

throughout the city.[118] The editor of a neighborhood newspaper from Meehan's own ward, the *Germantown Telegraph*, denounced him. An editorial appeared in the *Philadelphia Press:*

> The people of Philadelphia owe a good deal to Mr. Thomas Meehan and respect him. He has been the persistent advocate and promoter of a liberal and widely extended system of small parks. Almost alone among Councilmen he has shown an intelligent interest in the subject of street shade trees. He knows what they should be and what is their value. If his efforts could have accomplished it, we would before this have had a fish hatchery on the banks of the Schuylkill east of the Zoological Garden. When a city forester was to be selected, everyone recognized the fitness of Mr. Thomas Meehan's appointment as one of the commissioners to examine the applications and recommend a fit person for city forester and gardener.
>
> It was to be presumed, therefore, judging from his usual liberal and progressive spirit, that Mr. Meehan would be found leading the ranks of the filtrationists. This the more because he comes from Germantown, that wealthy and enlightened suburb of Philadelphia, which labors under the disadvantage of having the worst water of any portion of the city. … It is amazing, therefore, that an intelligent Germantown Councilman should be found leading the forces of reaction, prejudice and ignorance against filtration. … We welcome the statement that Mr. Meehan believes filtration would be a benefit to the entire city and that he only opposes it because of the supposed long wait for its benefit that some sections would have to endure. Let him lead a crusade for filtration for the entire city and readjust his time estimate by consulting competent engineers. Then will the Germantown Councilman be again worthy of his reputation and be withdrawn from his alliance with mossbacks, the uninstructed and the uninstructible [*sic*], who assisted him in killing the $250,000 appropriation[119] for making a

[118] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 37.
[119] The equivalent of approximately $8.8 million in 2022.

start toward the filtration of the city's water.[120]

In this political climate, three reports on the water quality in Philadelphia were published, one each in April[121] and May,[122] and one in August.[123] The first detailed the problem of coal dust fouling the Schuylkill River. The latter two were more damning of the cleanliness of the water supply across the city in general. The steady drip, drip of negative publicity increased public outcry for a solution. As the vote in March had shown, a majority in the Common Council at least was already supportive of filtration and public pressure brought more around. That November, instead of attempting to directly fund city-wide filtration, the Common Council approved a bond issue, voting 99–3 in favor, with Meehan still in opposition.[124] The next month the Select Council voted 33–1 to approve the measure. With a voter insurrection in his ward becoming increasingly likely, Meehan capitulated within a year and pledged to support filtration.[125]

The prospect for filtration hit a legal snag in January 1897, however. A challenge to the bond bill (as well as to another bond bill for $8 million[126] passed in 1896 to fund a number of unrelated projects) was making its way through the court system. City Council's joint finance committee decided it needed to be on sound footing and voted to not move ahead with filtration plans until the legality was settled. This was prudent and not unexpected, but it was still

[120] *Philadelphia Press* (27 Mar 1896), clipping in scrapbook in papers of Frank J. Firth, Germantown Historical Society, quoted in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 37f.
[121] Bureau of Water, *Chief Engineer's 1895 Annual Report* (6 Apr 1896), 74.
[122] George S. Hughes, Chief Inspector of House Drainage, Bureau of Health, *Vicinity of Philadelphia: Report by George S. Hughes* (Philadelphia:L 29 May 1896).
[123] John C. Trautwine, Jr., *Schuylkill and Delaware Rivers: Report to Committee on River Conservancy Boards of Supervision of the American Public Health System* (Philadelphia: 19 Aug 1896).
[124] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 40.
[125] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 40n36.
[126] The equivalent of approximately $282 million in 2022.

frustrating.[127]

A common court judge ruled in May that the city was within its authority to increase its debt load by the $11 million[128] represented by the two bond bills. The same month the Pennsylvania Supreme Court agreed with the lower court but stipulated that City Council would need to pass a new bill and then obtain approval by the voters at a major election.[129]

The next election was in November of the same year. Voters were asked to approve a bill increasing the city's indebtedness by $12.2 million.[130] It included earmarks for various projects, including $3 million[131] for city-wide filtration facilities. The Democratic Party within Philadelphia opposed the bill and Republicans made a campaign issue of their apparent opposition to filtration. In the end the voters approved the measure by a solid majority, although by a narrower margin than was usual for referenda pushed by the Republican machine.[132] But the way was now clear for City Councils to issue bonds to fund filtration.

In the meantime, in April 1897 Trautwine had published the Bureau of Water's Annual Report for the previous year. It included a plan by an engineer named Allen Hazen, who had experience with successful slow-sand filtration systems elsewhere, for providing filtration for the city's entire water supply. Based on Hazen's cost estimate, Trautwine requested $3.5 million to carry out the plan.[133] The Fairmount Water Works, significantly, was not included in the

[127] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 41.
[128] The equivalent of approximately $393 million in 2022.
[129] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 41f.
[130] The equivalent of approximately $435 million in 2022.
[131] The equivalent of approximately $107 million in 2022.
[132] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 42.
[133] The equivalent of approximately $125 million in 2022.

proposal.[134]

No reasons for leaving Fairmount out of the plan were provided in the report but it's not hard to reconstruct them. As we have seen, not only would a filtration system at Fairmount be difficult to build, it would be difficult to justify. Fifteen years earlier, recall, a Board of Experts had been convened by the mayor to consider options for improving the water system. The four-member panel, which included Frederic Graff, Jr. himself, had declared that the water-powered operation at Fairmount could no longer be relied upon because the combination of low water flow and its wastefulness of water sidelined it during warm, dry weather when demand was highest. The board labeled Fairmount "practically unavailable" when needed most.[135] It made a number of recommendations for improving the water system; none involved expansion of operations at Fairmount.[136]

Now fifteen years later, the circumstances were even worse. Newer steam-powered pumping stations located upstream were not affected by summer droughts, as water-powered Fairmount was. At the same time, these same stations made the situation at Fairmount worse by drawing down the water level behind Fairmount Dam, especially during dry periods, and decreasing the potential energy for use there.[137] And after being perennially starved for maintenance funds, the turbines and pumps were becoming increasingly costly to operate.[138] They were now more of a liability than an asset.

Worst of all, by 1895 water from Fairmount accounted for just 9.6 percent of the total

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[134] Allen Hazen, *A Practical Plan for Sand Filtration as a Means of Serving a Better Water Supply for the City of Philadelphia*, in Bureau of Water, *Chief Engineer's 1896 Annual Report,* (5 Apr 1897), Appendix N, 381ff, remarks by Trautwine at 121f.
[135] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 152.
[136] Water Department, *Chief Engineer's 1882 Annual Report* (15 Feb 1883), 151ff.
[137] Bureau of Water, *Chief Engineer's 1895 Annual Report* (6 Apr 1896), 130; Bureau of Water, *Chief Engineer's 1896 Annual Report* (5 Apr 1897), 89.
[138] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 10; Bureau of Water, *Chief Engineer's 1905 Annual Report* (2 Apr 1906), 60.

pumped into the city's distribution system. Officially labeled an "auxiliary" facility, the Fairmount Water Works had become marginalized.[139] Spending a large amount of money to build a filtration system at Fairmount made neither financial nor operational sense.

City Councils now had $3 million[140] set aside for city-wide filtration, but this was less than the $3.5 million[141] Trautwine had requested earlier in the year. Truth be told, even the $3.5 million request was low-balling it since it was based upon water consumption as Trautwine thought it should be, not as it actually was. Trautwine was still thinking meters were a possibility. He believed metering would reduce the amount of filtration capacity which would be necessary to construct and therefore save money. If that were successful, perhaps the $3 million would be sufficient.

Pushing meters was just not a realistic proposition, however. Public opposition to metering never diminished during this time.[142] Finally abandoning his expectations for metering, Trautwine released a more clear-eyed cost estimate for city-wide filtration: eight to ten million dollars[143] for a system of facilities able to filter the daily consumption reasonably expected within ten years.[144]

The higher estimate gave City Council pause. In response, it pulled back from filtration and considered two aqueduct proposals.

Six years earlier, in 1891, industrialist Joseph Wharton[145] had informally proposed to

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[139] Bureau of Water, *Chief Engineer's 1895 Annual Report* (6 Apr 1896), 130.
[140] The equivalent of approximately $107 million in 2022.
[141] The equivalent of approximately $125 million in 2022.
[142] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 43.
[143] The equivalent of approximately $185–357 million in 2022.
[144] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 43f.
[145] Industrialist Joseph Wharton (1826–1909) was involved in mining, manufacturing, and education. He founded the Wharton School of Business at the University of Pennsylvania and co-founded Bethlehem Steel. See Andrew J.

City Council to bring in water from vast tracts of property he owned in the area of the Pine Barrens in southern New Jersey.[146] Three problems doomed the idea, however. Wharton never provided much in the way of detail, allowing the suggestion to remain nebulous and undefined. The source of water would be controlled by another state, a politically unacceptable circumstance. And because of tannins in the soil, the water in the pine barrens is brown, the color of tea. It doesn't taste or smell bad but is visually off-putting and tends to stain. One would think this last issue alone would have nixed the idea. Would the citizens of Philadelphia be persuaded to approve spending a lot of money to bring in brown water from out of state? Not likely. Vague and impractical though it was, the plan was investigated and evaluated but it was more or less a non-starter.

The second proposal, pitched by the Schuylkill Valley Water Company, was taken more seriously by City Council.[147] The company, an ad hoc consortium of construction contractors, offered to build an aqueduct to deliver water to the city from the Schuylkill River between Norristown and Reading where it would construct numerous dams designed to hold a total of approximately 18 billion gallons. The plan would also see an intake and filtration station on the Delaware River to supply northeast Philadelphia. The group pledged completion within three years and payment of penalties if it failed to meet its deadline. The city would pay the consortium $1.5 million[148] annually for fifty years (the approximate amount the city collected in water rents at the time), after which control of the system would be handed to the city.

The plan had numerous problems. Since it would require massive flooding of significant

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Turner, "Joseph Wharton," *Pennsylvania Center for the Book, The Pennsylvania State University* (2007), <https://pabook.libraries.psu.edu/literary-cultural-heritage-map-pa/bios/wharton_joseph>, accessed 6 Oct 2020.

[146] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 44ff.

[147] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 46.

[148] The equivalent of approximately $53.5 million in 2022.

portions of the Schuylkill River, expected litigation would certainly tie up the project in the courts and delay construction for years. And the proposed capacity of the dams would still not be enough to meet the expected level of water consumption in the near future. The system would not be under the control of the city, a severe political liability.[149]

In addition to the legal, operational, and political issues, there were serious fiscal drawbacks; the proposal was not nearly as financially attractive as its promoters made it seem. The city would pay $75 million altogether[150] for a system that would cost the company an estimated $10 million to build.[151] There would be maintenance costs to the company over the years, of course, but at the end of the fifty-year period, the city would have overpaid to take control of an aging system that would need serious work or outright replacement. In the meantime, all of the city's revenue from water rents would be spoken for. Paying the interest on bonds notwithstanding, funding construction with an up-front bond issue would be far less costly to the city and would allow it to maintain control from the beginning.[152]

The Schuylkill Valley Water Company's plan made little sense for the city. Mayor Warwick disapproved of it, Trautwine was hostile to it, and the chairmen of City Councils' joint finance committee agreed with them. Numerous civic organizations and professional societies lined up in opposition.[153] After an initial exploration, the Schuylkill Valley Water Company's proposal should have been as much of a dead letter as Wharton's. The following year, however, the reason for the continued interest by City Councils became maddeningly clear.

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[149] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 46.
[150] The equivalent of approximately $2.6 billion in 2022.
[151] The equivalent of approximately $357 million in 2022.
[152] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 46f.
[153] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 46.

City Councils had been inching their way toward the funding of some sort of filtration system. The movement may have been tentative and halting but it was in the right direction. Throughout 1897, however, City Councils had rather inexplicably continued to consider a proposed aqueduct system long after all other stakeholders had rejected it as being bad for the City. In early 1898 Councils went full tilt for the aqueduct, despite the financial and technical problems it posed for the city.

Backers of the Schuylkill Valley Water Company's aqueduct proposal, led by Councilman Edward W. Patton, a machine politician, Penrose associate, and obstructionist toward Mayor Warwick, were successful in blocking the passage of a bill appropriating funds from the filtration bond sale. On 1 March the Select Council went further and voted 22–14 to approve construction of the proposed aqueduct project.[154]

The aqueduct funding bill was sent to the Common Council where it looked like it would pass. It never made it out of the lower chamber, however. The aqueduct effort collapsed because of the revelation of the reason for City Councils' interest in the scheme in the first place.

On 10 March Common Councilman Robert Stevenson, an undistinguished, soft-spoken, back-bencher Republican, addressed the chamber with the permission of the chair. Tentatively at first, then more forcefully, Stevenson declared to the Council that he had been offered a bribe of $5,000[155]—which he had refused—to vote for the Schuylkill Valley Water Company aqueduct bill.[156] Moreover, he said he had been told that all of the councilmen who would be voting in the affirmative had received between $1,000 and $5,000 for their support.[157]

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[154] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 47.
[155] The equivalent of approximately $178,400 in 2022.
[156] Clinton R. Woodruff, "Philadelphia's Water: A Story of Municipal Procrastination," *The Forum*, Vol. 28, (New York: The Forum Publishing Company, Nov 1889), 309f.
[157] The equivalent of approximately $35,600–178,400 in 2022.

The council proceedings quickly degenerated into chaos. An indefinite postponement of further action on the bill was requested. It was narrowly passed, 67–62, over the strenuous objection and exertion of the Patton faction.

District Attorney George S. Graham began an investigation. An independent Republican, Graham had long been in office and was highly respected as a proverbial straight arrow. A long-time friend and mentor to Mayor Warwick, he despised corruption and the machine soil of politics in which it grew. The investigation revealed that numerous councilmen had indeed taken bribes in exchange for their support of the aqueduct scheme. The bribes were offered by, and paid through, Peter E. Smith, a member of the Republican city committee. Smith had been so indiscreet about it all that his actions were an open secret for months. The bribery money ultimately came from Nelson Green, the Schuylkill Valley Water Company's primary lobbyist, although he was careful to remain at least one step removed so as to be able to maintain plausible deniability.

Graham soon brought charges against Smith. In open court he maneuvered one councilman into admitting taking bribes and naming others who did. Numerous witnesses testified against Smith and described how Green had spoken of having councilmen in his pocket through bribery. Despite all of this, however, nothing could be proven and no one was convicted.

The bribery scandal was dramatic and cemented in people's minds the association of corruption with those in city government who opposed filtration. Even without the scandal, the Schuylkill Valley Water Company bill would probably never have become law. Mayor Warwick pledged a veto of the legislation if it passed and supporters of the bill did not have the votes needed to override it. The scandal, however, practically guaranteed the arrangement would

fail.[158]

While the metaphorical rot in City Councils had been made evident to all, filth of a more literal nature demonstrated just how precarious the health of the city really was. At two o'clock in the afternoon of Tuesday 16 Nov 1897, a sewer-cleaning crew overloaded the interceptor sewer along the east side of the Schuylkill River with water, causing it to back up and overflow into the river immediately upstream of the Queen Lane intake. Unfortunately, the crew delayed reporting the incident. Not knowing of the discharge, workers at Queen Lane stopped the pumps only after discovering polluted water in the reservoir about two hours later. At nine o'clock that evening, the Bureau of Water shut down the pumps at the three stations downstream of Queen Lane—Belmont, Spring Garden, and Fairmount—after residents in the district supplied by the Fairmount Water Works began to report that their water tasted foul. The pumps were not started again until the next afternoon.[159]

Testing showed the water in the Queen Lane reservoir had a high bacteria count but that didn't necessarily mean that it was dangerous. That often happened when the water was turbid after a period of rain such as had been occurring for the preceding few days. How bad the situation was they could not tell. There was no way to know for sure. In any case, it was now out of their control. Since typhoid has an incubation period of several weeks, the Bureau of Water and Board of Health could only sit tight and wait to see what would happen next.

It took over four weeks but eventually the result became apparent and it was painful. The number of typhoid cases doubled to 400 for the month of December and increased in all of the city's 38 wards except three. The situation was most dire in the seven wards which received

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[158] The bribery scandal is described in greater detail in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 47ff.
[159] Bureau of Water, *Chief Engineer's 1897 Annual Report* (26 Jan 1898), 78ff.

water from the Queen Lane Works; those wards saw 53% of the total number of cases. Contrary to expectations of a tapering off, the number of new typhoid cases more than doubled again in January of 1898, reaching 860 before dropping in February to 670. New cases declined in March to 362 and then fell to 196, approximately normal numbers, in April.[160]

For years the local newspapers had been telling people to boil their tap water before drinking it or cooking with it. City officials reiterated this advice. Eleven years earlier, Dr. Hartshorne had wondered why the precaution should be necessary at all.[161] Public frustration had only grown since.

As the filtration debate dragged on, routine pollution in the Schuylkill River continued to be a significant problem. Before it enters Philadelphia, the river meanders through Montgomery County for some 35 miles. In the spring of 1898, the Philadelphia Board of Health sent members of its staff to conduct a survey of possible sources of contamination upstream.[162] One of the areas that was examined was the southernmost corner of Montgomery County, located on the west side of the Schuylkill River opposite the city's Manayunk and Roxborough neighborhoods. The Board chose to take a close look at communities in this area because a handful of small streams combine there to form Mill Creek which flows down Penn Valley and empties into the Schuylkill River at a point just above and opposite the Roxborough Works' intake and pumping station.

What the staffers documented was shocking to some but unsurprising to those already familiar with the state of affairs. There were numerous small textile mills and other factories

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[160] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 53f.
[161] Henry Hartshorne, M.D., *Our Water Supply: What It Is and What It Should Be* (1889), 18.
[162] Bureau of Health, *Sources of Pollution—Schuylkill River* (Philadelphia: 1898); Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 54f.

emptying waste into the streams. The Thomas Clegg carpet mill repurposed an abandoned mill race flowing into Mill Creek as an open sewer serving six toilets used by employees. Six houses had privies which also drained into the race. Another mill even had a privy located directly above Mill Creek itself.

As if to remind everyone of the danger of delay, during the summer the residents of the Mt. Airy neighborhood began complaining that their water had been tasting and smelling particularly foul for a week. It turns out that a dead horse had floated down the Plymouth Creek and into the Schuylkill River at Conshohocken. The putrefying animal was on the Montgomery County side of the river, however, not Philadelphia, so City officials had no jurisdiction and had to request its removal by the state Board of Health.

While the request wended its way from the Philadelphia Police Department to the city Bureau of Health and from there to the state agency, the bloating carcass had slowly floated down past the Shawmont intake of the Roxborough Works to the Philadelphia side of the Flat Rock Dam in the Manayunk neighborhood, where City workers finally fished it out. The Shawmont intake continued to pump contaminated water into the Roxborough Reservoir and on to Mt. Airy the entire while.[163]

Fortunately, the dead animal did not cause another outbreak of disease, but the incident did serve to further underline the problem. Without filtration, the citizens of Philadelphia were at the complete mercy of not just dangerous accidents but the thoughtless actions of any heedless person who thought nothing of contaminating with their own waste the drinking water of tens of thousands of people downstream. The situation was increasingly recognized as intolerable.

It was also becoming increasingly apparent that the only workable remedy to the

[163] "Befouled the Water," *Philadelphia Inquirer* (7 Jul 1898), 2.

defenselessness was filtration of the existing water supply.[164]

In July 1898, City Councils asked Trautwine to provide an updated report with recommendations and cost estimates. The Chief Engineer submitted his report three months later.[165] He declared that waste was still the key factor, estimating that 60% of water consumption was wasted. He said constructing filtration plants for the entire current water demand would cost over $7 million,[166] but that could be lowered to $2.3 million[167] if the waste were reduced through metering. Trautwine recommended meters for all factories and for the estimated 20 percent of homeowners he believed were wasting water. As historian Michael P. McCarthy put it, "If nothing else, Trautwine was consistent."[168] He also recommended construction of an experimental filtration system followed by slow sand filters for all pumping stations except Queen Lane for which he recommended rapid sand (mechanical) filters because of space constraints there.

Trautwine summarized his report by recommending three priorities, in the following order: Installation of meters (to reduce waste and thus the cost of filtration plants), construction of an experimental station (to test various filtration methods, demonstrate their effectiveness, and build public support for city-wide deployment), and finally implementation of city-wide deployment of filtration.

Thomas Thompson, head of the Department of Public Works, was disappointed with Trautwine's report. He didn't think that water waste was as bad as Trautwine claimed. He was

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[164] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 58.
[165] *Journal of the Common Council, Appendix 3, 6 Oct 1898–30 Mar 1899* (Philadelphia, 1899), 45; cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 58f.
[166] The equivalent of approximately $250 million in 2022.
[167] The equivalent of approximately $82 million in 2022.
[168] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 59.

skeptical of rapid sand (mechanical) filters; they required treating the water with aluminum sulfate or similar reagent and, like many, he was wary of adding chemicals. Thompson especially, however, wanted to greatly reduce the city's dependence on the Schuylkill River, the source for over 90 percent of the city's water, by increasing the supply from the Delaware River, which was cleaner upstream of any intake in northeast Philadelphia. Thompson asserted that if a slow sand filter system were built at Torresdale, so much water could be supplied by the Delaware River that there would be no need for rapid sand filters at Queen Lane.[169]

Thompson's disagreements with Trautwine highlighted differences of opinion within the city's administration as well as within the professional community. Despite the uncertainty caused by disagreement over Trautwine's report, however, in the autumn of 1898 City Councils did make a number of decisions. Public opinion was still as squarely opposed to metering as it ever was.[170] Councils decided to keep the filtering and metering issues separate and table consideration of metering. The consensus was that rapid sand filters should be used only if absolutely necessary. Because of this there was little support for Trautwine's request for an experimental station since it was to be used for testing of rapid sand filters.[171]

Mayor Warwick was limited by recent changes to the City Charter to one term in office. In February 1899 Samuel H. Ashbridge was elected mayor; he would take office the following April. The day after the election, City Councils' joint water committee asked Thompson and his Department of Public Works to submit a proposal it could use as the basis for legislation to

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[169] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 59f.
[170] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 60.
[171] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 60f.

implement city-wide slow sand filtration.[172]

In mid-January the Select Council had begun consideration of a bill which would authorize a group calling itself the Quaker City Water Company to construct an intake and filtration station on the Delaware River. The sponsor of the bill was one of the councilmen involved in the Schuylkill Valley Water Company scandal, however, and the company's lobbyist was none other than Nelson Green himself. The company even operated out of the same offices. The brashness was breathtaking. After the press denounced the idea, members of the Common Council and Mayor-elect Ashbridge publicly voiced their disapproval. Within a week, the Common Council unanimously passed a resolution opposing it and the effort ran out of steam.[173]

The same day that Common Council passed the resolution that effectively killed the Quaker City Water Company proposal, 26 January 1899, it also passed a bill allocating $3.2 million[174] for filtration plants on the Schuylkill River, incorporating the suggestions it had requested from Thompson three months earlier.[175] In the Select Council, however, opponents of Mayor Warwick, who was still in office, delayed action on the bill for weeks. If the reformers in the Warwick administration were for it, the machine politicians were against it. They also relished the opportunity to embarrass the lame-duck mayor in retaliation for helping to kill the Quaker City proposal—their latest scheme for potentially lucrative contract money funneled through favored construction contractors.[176] When the appropriation bill was finally voted on in the Select Council in March, it was defeated. There were 24 yeas to 13 nays; a majority voted for

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[172] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 68.
[173] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 66ff.
[174] The equivalent of approximately $114 million in 2022.
[175] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 68.
[176] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 68.

it, but just barely less than the two thirds necessary to pass funding legislation.[177]

While members of Select Council were engaging in obstructionist politics, typhoid cases began to rise again, increasing in January and climbing more steeply in February. The cause of the outbreak turned out to be merely the typical ongoing pollution of the Schuylkill River, exacerbated in February by snow melt from a blizzard that month.[178] The *Philadelphia Inquirer* published a blistering editorial against City Council for its continued inaction in the face of the ongoing typhoid crisis.[179]

In the middle of this protracted indecision and gamesmanship, Alexander C. Abbott, M.D., head of the Bureau of Health's bacteriology department, gave an interview to the *Public Ledger* that was spectacularly ill-advised and muddied the waters considerably. While discussing the filtration issue, Abbott stated that not even the best of filters could catch all of the bacteria that cause typhoid. This was true, of course, but 100 percent effectiveness was not necessary to greatly reduce the typhoid rate and save lives. He added that boiling the water was the only way to kill all the typhoid bacilli. Again, true but misleading. Talk like this was perfectly reasonable from one scientist to another, but before the public it just increased confusion and made it seem like any money spent on filtration would be wasted.[180]

Less than two weeks after Dr. Abbott's tone-deaf remarks, the Select Council voted 18 to 10 in favor of a bill matching the Common Council's bill to fund filtration plants on the Schuylkill River. Although the positive movement was promising, the count was three votes

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[177] *Public Ledger* (24 Mar 1899); quoted in Clinton R. Woodruff, "Philadelphia's Water: A Story of Municipal Procrastination," *The Forum*, Vol. 28, (New York: The Forum Publishing Company, Nov 1889), 313.
[178] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 68f.
[179] *Philadelphia Inquirer* (20 Feb 1899); cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 69.
[180] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 77f.

short of the two thirds majority needed to pass appropriation bills. Two weeks later, on 23 March 1899,[181] after much political maneuvering, the Select Council again attempted to pass the bill, this time voting 24–13, again three votes shy of a two thirds majority.[182] Passage failed despite protracted public demonstration leading up to the vote and vocal support by civic groups present during the debate.[183] In a bitter editorial, the *Public Ledger* called the Select Council members who voted nay "the typhoid thirteen."[184]

In seeking to explain the opposition to the filtration bills this time around, four factors seem to stand out. There was Trautwine's insistence on pushing universally unpopular meters, Abbott's ridiculous remarks, and nay votes from councilmen representing wards not benefiting from the limited initial filtration. The biggest reason, however, didn't come to light until a few years later—the desire of the political machine to delay the awarding of construction contracts until after Ashbridge became mayor, when it would be much easier to direct the money to favored contractors.[185]

Ashbridge had served for many years as the city coroner and was extremely popular with the voting public because of his constant glad-handing and speech-making. Although not the political machine's first choice, he turned out to be all-in as a machine politician,[186] once going

[181] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 74.
[182] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 76.
[183] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 74ff.
[184] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 78.
[185] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 78f; Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 577.
[186] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 575ff. As mayor, Ashbridge turned out to be one of the most corrupt of them all. See also Peter McCaffery, *When Bosses Ruled Philadelphia:*

so far as to confide to a colleague that "I want no other office when I am out of this one, and shall get out of this office all there is in it for Samuel H. Ashbridge."[187]

Almost immediately after Ashbridge took office on 3 April 1899, he created a commission of outside experts to investigate the water problem, identify requirements, evaluate the state of the science, and make recommendations by the time City Councils returned from summer recess in September. He named Rudolph Hering, Samuel M. Gray, and Joseph M. Wilson—all well-regarded, experienced engineers—and turned them loose.[188]

The three commissioners were thorough. They examined current facilities, inspected numerous watersheds, evaluated examples from other cities, and sifted through previous studies. The commission submitted its report on 15 Sep.[189] It concluded, in no uncertain terms, that no matter where the city's water came from, it would need to be filtered.[190] It determined that any system of aqueducts and reservoirs would be prohibitively expensive and in any event unnecessary since filtration would render water from the Schuylkill and Delaware Rivers safe. The commission recommended that all future supply increases be drawn from the Delaware River.[191] As we saw in the previous chapter, the Fairmount Water Works was not included in the

The Emergence of the Republican Machine, 1867–1933 (The Pennsylvania State University Press, 1993), 92ff, 101, 106f, 113f.

[187] Quoted in Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 576. Ashbridge made the admission to the City's postmaster, Thomas L. Hicks.

[188] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 79.

[189] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899). See also Board of Health, "First Annual Message of Samuel H. Ashbridge," *Annual Report* (1899), xvff, cited in Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 80.

[190] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 47.

[191] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 78.

filtration recommendation.[192]

The Fairmount Reservoir was specifically singled out for abandonment.[193] In addition to Fairmount's intermittent operation,[194] two reasons were provided—the reservoir's low elevation and the difficulty of constructing a co-located filtration facility.[195] Since the Fairmount Reservoir represented less than two percent of the entire reservoir capacity, closing it was not as radical an idea as it would seem at first glance.

By the end of the month, both chambers of City Council passed legislation approving a request by Mayor Ashbridge for a $12 million bond issue[196] to be added to funds already earmarked for filtration. Four days later the spending was approved in a public referendum.[197]

By early November, Trautwine resigned over his difference with Ashbridge on the mayor's prioritizing of filtration over metering. The mayor wasted no time in finding a replacement, appointing Frank L. Hand Chief Engineer of the Bureau of Water a week later.[198]

In mid-November Mayor Ashbridge proposed to City Council five funding ordinances to begin construction on filtration plants, altogether totaling $15.2 million[199]—$12 million approved in the recent referendum and $3.2 million from the earlier one. The $3.2 million was earmarked for filtration plants on the Schuylkill River while the $12 million would go toward

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[192] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 79.
[193] As was the Corinthian Avenue Reservoir.
[194] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 75. Recall that Fairmount Reservoir received water from only Turbines 1 and 3, and that the turbines were not run during the dry periods.
[195] Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia, *Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia* (Philadelphia, 15 Sep 1899), 79f.
[196] The equivalent of approximately $428 million in 2022.
[197] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 80.
[198] Bureau of Water, *Chief Engineer's 1899 Annual Report* (20 Jan 1900), 40, 61; Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 83.
[199] The equivalent of approximately $542 million in 2022.

other filtration plants and improvements to pumping stations, pipelines, and other water infrastructure.[200]

In January 1900, both chambers of City Council passed all five bills.[201] Filtration of Philadelphia's water supply was finally approved and funded.[202]

The Fairmount Water Works was not included.[203]

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Filtration had yet to be implemented but amid the push for it, an unrelated issue—the "uppercut" referred to at the beginning of this chapter—was beginning to emerge.[204]

For some time, advocates had been proposing some sort of wide, diagonal avenue from City Hall to the vicinity of the Fairmount Reservoir. The earliest came in 1871, before City Hall was even begun. The author of an anonymous pamphlet proposed that a series of avenues be created to lead from Penn Square (the renamed Centre Square) out to Fairmount so residents of

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[200] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 80.

[201] For example *Journal of the Common Council of the City of Philadelphia, From October 5, 1899, to March 29, 1900*, Vol. II, Appendix 180 (Philadelphia: Dunlap Printing Co., 1900), 447ff.

[202] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 80.

[203] The author-editor could find no documentation identifying the individual who made the final decision to close the Fairmount Water Works nor the date the decision was made. The closest thing is an oblique reference to the decision to shutter the plant when the Torresdale Filtration Plant became operational, by Bureau of Water Chief Engineer Frank L. Hand in his Annual Report for 1905. See Bureau of Water, *Chief Engineer's 1905 Annual Report* (19 Jan 1906), 60. Prior to that, after the adoption and funding of most of the recommendations of the Hering Commission in 1900 the Fairmount Water Works appeared on no list of pumping stations receiving improvements. Indeed, it was no longer included in any list of pumping stations at all, whether for calculating total system capacity or for any other reason. See for example Bureau of Water, *Chief Engineer's 1902 Annual Report* (19 Jan 1903), xxviiff,

[204] As with the account of filtration, a summary of the story of the development of the Fairmount Parkway (today called the Ben Franklin Parkway) and Philadelphia Museum of Art is included in the present work because it has direct bearing on the existential fate of the Fairmount Water Works.

the city could more easily travel to Fairmount Park and enjoy its healthful benefits.[205]

A more direct diagonal was proposed for the first time in 1884 by Charles K. Landis, the utopian who founded and developed Vineland, New Jersey.[206] By now, City Hall was under construction, and his route was a direct line from the grand municipal building to the Fairmount Reservoir. A poster promoting the idea sounded two themes which would become recurring motifs: "A Convenient Approach to the Park" and "Something Worthy of the Magnificent City of Philadelphia."[207]

As prominent citizens began calling for a grand boulevard akin to the Champs-Élysées in Paris, city leaders started to take the idea seriously. At the request of City Councils, Director of Public Works James H. Windrim produced in 1892 a design for a 160-foot-wide, tree-lined street, aligned with City Hall and the south side of the Fairmount Reservoir near the double-deck Callowhill Street Bridge. Less than two months after the proposal was presented, the mayor at the time signed legislation adding the parkway to the city map. Planning languished, however, when Councils failed to fund the effort.

Gradually, proponents of the parkway began to think of it as far more important than simply a more convenient way to get to Fairmount Park. They began to see it as crucial to the economic and cultural future of the city. As lawyer and longtime advocate James M. Beck

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[205] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 15f. The author-editor is indebted to Brownlee's landmark work. The Frances Shapiro-Weitzenhoffer Professor Emeritus of 19th Century European Art at the University of Pennsylvania, Brownlee served for 16 years on the Philadelphia Historical Commission and currently serves on the boards of the Design Advocacy Group of Philadelphia, the Preservation Alliance for Greater Philadelphia, the Athenaeum of Philadelphia, the Beth Sholom Preservation Foundation, and the Global Philadelphia Association's World Heritage City project. See "David Brownlee," *Penn History of Art, University of Pennsylvania* (2022), <https://arth.sas.upenn.edu/people/david-brownlee>, accessed 28 Jun 2022.

[206] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 16.

[207] Charles K. Landis, *Map of the Grand Avenue to the Park* (29 April 1884), collection of Mrs. Joseph Carson, Philadelphia.

argued in 1894, “that American city which first appreciates the utility of mere beauty will ultimately lead our Western civilization.”[208]

Despite robust advocacy from some quarters, however, support for a parkway waned. The “good government” movement sought to emphasize spending money on what was considered more practical projects which would have more of a direct and measurable effect on the city’s economic growth. Mayor Stuart announced his intention to veto any funding for the parkway and City Councils removed it from the planning map in December of 1894.[209]

Odd proposals like one put forth in 1900 by Wilson Eyre, Jr., and Albert Kelsey, which centered the roadway on the Cathedral Basilica of Sts. Peter and Paul, didn’t the advance the effort. With its axis bent at Logan Square, its views blocked by the dome of the cathedral, and its western terminus at the Washington Monument statue instead of Fairmount, it failed to inspire.[210]

In 1902 architect William J. McAuley produced for a group of parkway supporters a design which featured a diagonal parkway which ran from the tower of City Hall straight to the southeastern point of Fairmount. The proposal began to pick up increasing numbers of supporters among the city’s business leaders and politicos. Why the sudden surge in support? As historian David B. Brownlee noted, “[a]n invincible alliance had been created between powerful citizens and corrupt politicians.”[211] Signing legislation a few months later, Mayor Samuel H. Ashbridge, placed the parkway back on the city map, where it was to remain.

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[208] “A Boulevard Will Beautify the City.” *Inquirer* (15 Apr 1894) 5, quoted in David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Museum of Art, 1989), 18.

[209] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 18.

[210] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 19.

[211] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 20.

In the illustrated booklet which was widely distributed to promote the plan, there appeared something for the first time. Inscribed over the location of Fairmount were the words: "ART MUSEUM ON RESERVOIR."[212]

Leaders in Philadelphia's art community had been pushing for a replacement art museum since the early 1890s. The Pennsylvania Museum and School of Industrial Art[213] had since 1877 made its home in Memorial Hall in the West Park portion of Fairmount Park, west of the Schuylkill River. Constructed as an art gallery for the Centennial Exhibition of 1876, the building no longer functioned very well in that role. Art acquisitions and increasing numbers of visitors had made space tight, hanging arrangements were difficult, and the lighting was poor (much of it being provided by skylights created before the era of electric light). The building's owner, the Fairmount Park Commission, thought improvements were a waste of money.[214]

Peter A. B. Widener, the wealthy streetcar magnate, suburban developer, and art collector, pledged to donate his huge collection of art to the museum if the city would build a new facility. A member of the Fairmount Park Commission since 1889,[215] Widener in 1894 proposed building a new museum on Lemon Hill, closer to the core of the city but still within the park.[216] The Commission held an open competition for the design the next year,[217] but suspicions of favoritism by the jury panel and other controversies caused enthusiasm to dissipate.[218] For

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[212] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 20, Fig. 12.
[213] The institution is today known as the Philadelphia Museum of Art. The name was changed in 1938.
[214] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 39f.
[215] Fairmount Park Commission, *1915 Annual Report* (12 Jan 1916), 3.
[216] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 40.
[217] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 40.
[218] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 43.

years City Council appropriated no funds for the project.[219]

Shortly after the turn of the twentieth century, however, stakeholders in the two proposed projects—a grand parkway and an art museum—began to realize that their interests overlapped and could be mutually beneficial. Noticing the City's reluctance to construct a filtration facility at the Fairmount Water Works, Widener in 1903 floated the idea of situating a new art museum atop Fairmount in place of the reservoir.[220] Proponents of the parkway recognized the potential boost that an impressive edifice at its western terminus could do for their project as well. The parkway was recast as a grand location for museums and cultural institutions of all types.[221] The Department of Public Works included a plan for an art museum atop Fairmount in a 1903 report.[222] The next year Mayor John Weaver advocated for the idea in an address to the Fairmount Park Art Association.[223] The parkway and art museum stars were beginning to align.

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In January 1901 Mayor Ashbridge described the importance and magnitude of the filtration effort in his third annual address:

> Never in the history of our City has so important a work confronted the people as that of

[219] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 43f.
[220] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 44.
[221] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 44, 71ff.
[222] As published in "Park Approaches," *Sixteenth Annual Report of the City Parks Association of Philadelphia* (1904), 9f, as cited in David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 44. A fold-out map was even included.
[223] "Address of Hon. John Weaver, Mayor of Philadelphia," *Fairmount Park Art Association Thirty-Third Annual Report…,* No. 39 (1905), 28; as cited in David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 44.

> the filtration of the water. It touches the very health and life of the community, and much greater attention has been given to this important subject than to perhaps all of the other matters of municipal improvements combined. I do not believe but a small percentage of our citizens recognize the stupendous task taken up by the engineers in charge of the work.[224]

The same month the mayor brought in John W. Hill, a hydraulic engineer who specialized in filtration systems and was connected with the machine of political boss George Cox's in Cincinnati, Ohio, to head the filtration effort as "Consultant Engineer."[225] In order to manage the massive program of design and construction, City Councils in July 1902 created the Bureau of Filtration, splitting it off from the Bureau of Water. Ashbridge appointed Hill Chief Engineer of the new bureau.[226]

After a year of design work, construction began on the first filtration plant, Lower Roxborough on the east side of the Schuylkill River, in early April 1901.[227] Within two months work started on the Upper Roxborough plant[228] and within three the Belmont filtration plant, on the west side of the Schuylkill, was under construction.[229] In June 1902 the Lower Roxborough filtration plant was completed[230] and, after testing, began supplying the first filtered water to Philadelphians, in the Manayunk area on 12 Aug, followed by residents in the lower portion of Germantown near the end of September.[231] Two years later, in the middle of September 1904,

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[224] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), xvi.
[225] Bureau of Water, *Chief Engineer's 1900 Annual Report* (Feb 1901), 22; Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 8, 219; Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena*, Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 578f. The editors of the monthly publication *The Arena* serialized Blankenburg's essay on political corruption in Philadelphia in eight parts, from January to August 1905.
[226] Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 225, 227. Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 109.
[227] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 241.
[228] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 246.
[229] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 262.
[230] Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 231.
[231] Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 244.

the Belmont filtration plant became operational.[232]

In January 1902 construction started on the largest intake and filtration plant of them all.[233] Located on the Delaware River in what was then a rural area of northeast Philadelphia, the Torresdale Filtration Plant was designed to supply most of the city with filtered water and greatly reduce the dependence on the Schuylkill River.[234] Less than two months earlier, work on the Torresdale Conduit, a necessary connection from the Torresdale Plant, was begun.[235] Designed to carry filtered water from the Torresdale Plant south to the Lardner's Point Station for pumping to other areas of the city,[236] the conduit was a 2.6-mile-long pipeline tunneled through bedrock one hundred feet below ground. It was constructed of brick and concrete, with an intended finished interior diameter of ten feet, six inches.[237]

As filtered water began to be supplied to residents in certain areas, the effect on the typhoid rate was dramatic. In 1904, areas supplied by the Roxborough filters had over a 65 percent lower rate than areas which received raw Delaware River water and over a 78 percent lower rate than West Philadelphia which received raw Schuylkill River water.[238] In 1905, areas of West Philadelphia which began receiving filtered water from the Belmont Plant saw over a 90 percent lower rate of typhoid than neighboring areas still receiving raw water from the Schuylkill.[239] The difference was so stark that when the following year a cluster of typhoid cases

[232] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 213.
[233] Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 238. A thorough description of the facility may be found at Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 271ff.
[234] Bureau of Filtration, *Chief Engineer's 1902 Annual Report* (31 Dec 1902), 228.
[235] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 254.
[236] Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 279ff; Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 164.
[237] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 250. A thorough description of the facility may be found at Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 247ff; and Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 274ff.
[238] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 308.
[239] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 211.

appeared on the filtered side of the dividing line in West Philadelphia, officials were immediately able to pinpoint the cause as two valves improperly left partially open, allowing cross-contamination by raw water.[240]

The Chief Engineer of the Bureau of Filtration was moved to conclude:

> … typhoid fever in Philadelphia come [*sic*] almost entirely from the drinking water, and that slow sand filtration, as far as the Schuylkill is concerned, entirely removes the disease germs.[241]

That same year, the decision was made to shut down the Fairmount Water Works when the Torresdale Filtration Plant, still under construction, became operational.[242]

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In addition to the reasons already noted—the erratic nature of the Schuylkill River, Fairmount's wastefulness of water, aging machinery, diminished reliability, reduced share of the overall water supply, a reservoir with an ever-smaller service area, and unfeasibility of a filtration facility nearby—the mounting pressure by powerful interests to give up the site of the Fairmount Reservoir for a new art museum is what truly seems to have tipped the scale for decision-makers.

More than the cherry atop the sundae, the push for an art museum at the end of the parkway became so strong that in combination with Fairmount's laundry list of troubles, the closure of the Fairmount Water Works was only a matter of time. The operational challenges of

[240] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 218.
[241] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 218.
[242] Bureau of Water, *Chief Engineer's 1905 Annual Report* (2 Apr 1906), 60.

Fairmount and the parkway-art museum initiative strongly reinforced each other.

Everyone was getting what they wanted. The mayor and City Councils would have a high-visibility symbol of progress in the form of a budding Champs-Élysées with a majestic western terminus, the art community would receive a monumental new art museum, the populace would receive filtration of the water supply, and the Bureau of Water was grateful to be rid of what it saw as a white elephant. Even the well-connected contractors and political machine were happy; there would be lucrative construction deals and pocket-lining opportunities aplenty. The fate of the Fairmount Water Works was sealed. By this time, it never really had a chance.

With the constant prodding of groups like the Art Federation, Parkway Association, Fairmount Park Art Association, City Parks Association, myriad civic associations, the city's newspapers, and the political machine, City Councils found the funding for the parkway and properties along the right-of-way began to be acquired. Overall design work on the parkway was done by renowned architects, including Paul Philippe Cret and Jacques Gréber.[243] The first demolition—of a row house at 422 North 22nd Street—occurred on 22 February 1907.[244]

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[243] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 22ff, 30ff. Their names are pronounced "Pohl Fee-LEEP KRAY" and "Zhahk Gray-BAY."

[244] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 21. Although delayed by World War II the parkway, complete with the municipal art museum at its western end, would eventually be completed. Known at first as Fairmount Parkway, it was renamed Benjamin Franklin Parkway by City Councils in 1937.While it never attracted as many cultural institutions as originally hoped, it nonetheless cut a grand diagonal axis from center city to its immediate northwestern environs, from City Hall to a celebrated art museum atop Fairmount.

Peter A. B. Widener's collection never did make it into the museum. After Widener's death in 1915, his son Joseph E. Widener inherited the responsibility for the collection. In 1920 the younger Widener resigned from the Art Jury and withdrew his father's pledge in a pique of spite over his inability to keep recently deceased John C. Johnson's massive art collection out of the museum when Mayor J. Hampton Moore refused to accommodate Widener's demand for a separate gallery elsewhere for the other collection. Widener instead eventually donated the entire collection to the National Gallery in Washington, D.C. See David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 65, 68, 77, 115; "Widener Resigns as Chairman of City's Art Jury," *Philadelphia Inquirer* (23 Jul 1920), 1, 5; "Johnson Art Fund Remains Intact," *Philadelphia Inquirer* (24 Aug 1920), 2.

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One would be forgiven for thinking it was now full steam ahead toward full implementation of city-wide filtration. Throughout 1905 and 1906, however, yet another corruption scandal played out in city government and the press. This time it involved municipal malfeasance on a grand scale.[245] It also had a direct bearing on the timing of the closure of the Fairmount Water Works.

Ashbridge's successor as mayor was John Weaver. Although elected in February 1903 largely on the strength of his seemingly vigorous prosecution of a high-profile political corruption case as Philadelphia District Attorney a few years earlier, he was beholden to the machine which had helped him become DA in the first place.[246] To the general public he had a reputation as an honest reformer, but in reality he had helped maneuver a not-guilty verdict by various means such as assisting in witness tampering and jury packing.[247]

Taking office in April 1903, Weaver initially behaved as the machine expected him to. This included retaining John W. Hill as Chief Engineer of the Bureau of Filtration[248] and appointing corrupt politico Peter E. Costello[249] as his Director of Public Works,[250] to whom the

[245] *Philadelphia Press* (7 Jul 1901); *Public Ledger* (30 Oct 1905); Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 578f; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 108f.
[246] Rudolph Blankenburg, "Forty Years In the Wilderness: Philadelphia and the Freeman's Ballot," *The Arena,* Vol. XXXIII, No. 186 (The Brandt Press: Trenton, May 1905), 465, 468f. The trial was of Samuel Salter, a machine operative indicted in 1899 on charges of stuffing ballot boxes.
[247] Rudolph Blankenburg, "Forty Years In the Wilderness: Philadelphia and the Freeman's Ballot," *The Arena,* Vol. XXXIII, No. 186 (The Brandt Press: Trenton, May 1905), 467f, 469ff.
[248] Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 217.
[249] Costello was the 41st Ward leader and chairman of the Councils Finance committee; he was politically indebted to machine bosses Israel "Iz" Durham and James P. McNichol. See Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 92.
[250] Bureau of Water, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), i, xix, 3.

Chief Engineers of the Bureaus of Water and Filtration directly reported.

In early 1905, however, Israel "Iz" Durham, the machine boss in Philadelphia at the time, did something which upset the apple cart of Philadelphia politics. Since 1897 the United Gas Improvement Company (UGI) had been operating the Philadelphia Gas Works under a 30-year contract. The public had been ambivalent about the arrangement because prior to 1897 the Gas Works had been run by the City so poorly (it was a haven for patronage, among other things) that the plant was antiquated and run-down, the gas was poor, the cost was high, and there were frequent accidents.[251] Durham proposed a long-term contract by which UGI would lease the Gas Works from the City until the year 1980.

The proposed 75-year contract was such an obvious bad deal for the City, however, that the press and the public were overwhelmingly against it. Weaver broke with Durham and opposed the scheme. In order to strengthen his hand against the machine, moreover, Weaver decided to live up to his public reputation and make a display of the dishonest dealings of the machine.[252]

It had become an open secret that Bureau of Filtration Chief Engineer Hill and Public Works Director Costello had been colluding with the Philadelphia machine to direct lucrative filtration contracts to construction companies which were favored and shut out those who were not.[253] Favored contractors, naturally, were those who were willing to forward part of their contract payments on to the machine.

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[251] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Utter Darkness," *The Arena,* Vol. XXXIV, No. 188 (The Brandt Press: Trenton, Jul 1905), 28f.

[252] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Utter Darkness," *The Arena,* Vol. XXXIV, No. 188 (The Brandt Press: Trenton, Jul 1905), 29; Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 108f.

[253] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 576ff.

Weaver sacked Costello in May 1905.[254] Less than a month later he forced Hill to resign and replaced him with George S. Webster who was at the time Chief Engineer of the Bureau of Surveys.[255] By the end of July, the mayor suspended all of the work connected with the construction and equipment contracts for the Torresdale Filtration Plant, Torresdale Conduit, Lardner's Point Pumping Station, and the preliminary filtration system at Belmont.[256]

On 28 July[257] Weaver appointed a Board of Investigating Engineers to evaluate all of the contracts and work related to the filtration effort.[258] Led by Cassius E. Gillette, a major in the U.S. Army, the other two members were John D. Maclennan and William B. Parsons.[259]

The 47-year-old Gillette was an experienced hydraulic engineer who grew up in Tioga County, along Pennsylvania's northern tier. A graduate of the Military Academy at West Point, he had developed a record and reputation for exposing corruption. Maclennan recently had assisted in the construction of the water filtration system for Washington, D.C. Parsons worked on the groundbreaking New York City subway system and was in the midst of the construction of the Panama Canal. The three constituted a formidable team.[260]

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[254] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), xiii.
[255] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 153, 155; Bureau of Surveys, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 307. Webster did double duty as acting Chief Engineer while continuing as Chief Engineer of the Bureau of Surveys.
[256] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 155f.
[257] Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook*, courtesy of the Historical Society of Pennsylvania.
[258] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 155.
[259] McCarthy asserts that there was little or no malfeasance involved in the construction of the filtration facilities and that the investigation and resulting corruption scandal was politically motivated. (See Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 84ff.) The present work, however, will show conclusively that the contracting and construction process was pervaded by some of the worst corruption in the history of the City of Philadelphia up to that time. Politically motivated the probe may indeed have been, but there was more than enough corruption to justify it and the consequent scandal.
[260] "Major Gillette No Novice at Airing Crooked Contracts," *Philadelphia Press* (30 Oct 1905).

On 28 Oct the Board submitted its report to the Mayor.[261] It found that over 85 percent of the monetary value of the $18 million in contracts[262] that had been let up to June 1905[263] had been awarded to D. J. McNichol & Co. and other favored contractors.[264] The company was headed by Daniel J. McNichol, whose brother was James P. "Sunny Jim" McNichol, one of the machine bosses.[265] Iz Durham himself was a secret partner in the firm.[266] Daniel was the nominal head of the company but he only owned one twelfth of it; the rest was split between his brother and Durham.[267]

Discovering who was awarded contracts, and what the valuations were, was the easy part; anyone reading the Bureau of Filtration's annual report for the previous year would have a rough idea of that. More difficult, perhaps, was ferreting out how the contracts were funneled in the desired direction. The methods were as breathtaking for their variety as for their creativity.[268] Numerous techniques were employed, such as intimidating contractors into not bidding at all,

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[261] Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook,* courtesy of the Historical Society of Pennsylvania. Parsons was called away on national business before the report was finalized; consequently he does not appear as a signatory to the report.

[262] The equivalent of approximately $606 million in 2022.

[263] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 215ff.

[264] Bureau of Water, *Chief Engineer's 1905 Annual Report* (2 Apr 1906), 215ff; *Public Ledger* (30 Oct 1905); Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 108, 225n32. The total value of the contracts connected with the city-wide filtration project would grow to over $27 million by the end of 1908. Cf. Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 215ff; Bureau of Water, *Chief Engineer's 1908 Annual Report* (1 Jan 1909), 67ff.

[265] "Sunny Jim" McNichol was the machine boss in the area of the city north of Market Street. See Donald W. Disbrow, "Reform in Philadelphia Under Mayor Blankenburg, 1912–1916" *Pennsylvania History,* Vol. 27, No. 4 (Pennsylvania Historical Association, Oct 1960), 381.

[266] Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 102.

[267] Rudolph Blankenburg, "Forty Years In the Wilderness: Law and Order; After Clouds, Sunshine," *The Arena,* Vol. XXXIV, No. 189 (The Brandt Press: Trenton, Aug 1905), 140.

[268] Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook,* courtesy of the Historical Society of Pennsylvania.

withholding information necessary for making an intelligent bid, employing impossibly short advertising periods, encouraging collusion between contractors to rig bids, re-advertising contracts when bids from favored contractors weren't the lowest, awarding contracts to the "lowest *responsible* bidder"[269] instead of the lowest bidder, changing specifications after bids were received, sub-letting contracts, and specifying unreasonable completion times while delaying notice to proceed so favored contractors could accomplish preparatory work ahead of time.[270]

Perhaps worst of all was the practice of using specification change orders to harass and intimidate an unwanted contractor into abandoning a contract after they had started work. The contracts contained a clause which allowed the Director of the Department of Public Works to change specifications at will. In practice this sometimes took the form of written change orders but more often Hill or another Bureau of Filtration official, making arbitrary changes in the field, would simply declare on the spot that this or that piece of equipment was no longer allowed, a particular shipment of materials was no longer acceptable, or even an entire supplier was "out-of-spec."[271]

George C. Dietrich was an independent construction contractor who learned this the hard

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[269] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 41. Emphasis added.

[270] *Philadelphia Press* (7 Jul 1901); Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook,* courtesy of the Historical Society of Pennsylvania; *Public Ledger* (7 Jul 1906); Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 579f; Rudolph Blankenburg, "Forty Years In the Wilderness: Law and Order; After Clouds, Sunshine," *The Arena,* Vol. XXXIV, No. 189 (The Brandt Press: Trenton, Aug 1905), 129. The *Public Ledger* and *Philadelphia Press* were pro-business newspapers. The former ceased publication in 1942, the latter in 1920. The filtration contracts were not the only example of such practices. McNichol's construction company benefited in the same way during the building of the Northeast Boulevard (since 1918 called the Roosevelt Boulevard) a few years later. See Peter McCaffery, *When Bosses Ruled Philadelphia: The Emergence of the Republican Machine, 1867–1933* (The Pennsylvania State University Press, 1993), 92f.

[271] "Out-of-spec" or "out-of-specification" is a common engineering, contracting, and manufacturing term which means "does not meet the specifications called for, and agreed to, in a contract or other agreement."

way.[272] In 1902, when he successfully underbid McNichol for a medium-size contract to expand the Lardner's Point Pumping Station, the Bureau of Filtration promptly altered the plans and re-advertised the contract. Dietrich submitted a second bid and was again successful. Even with a $120,000 cushion[273] Dietrich programmed in for unexpected costs, his bid of $532,000[274] was a little over 25 percent lower than McNichol's.

Dietrich's difficulties began even before he started work. The bonding company he used was secretly in cahoots with the machine and dragged its heels for eight days toward the ten-day deadline for providing the necessary bond to the city. It then refused to provide the bond altogether, forcing Dietrich to scramble for another source lest he lose both the contract and $150 surety deposit[275] he had been required to put up.

The torment was just beginning. After Dietrich started work, Bureau of Filtration officials attempted to make things so difficult for him that he would abandon the job of his own volition. The Department of Public Works, for example, closed a street that Dietrich was using for access to the job site and delivery of materials by allowing McNichol's crew to dig an open trench across it and leave it open for five months, during which time Dietrich was forced to move all of his materials over a wood bridge the width of a single plank. Bureau of Filtration inspectors insisted Dietrich ensure the ground was completely dry before pouring concrete while they allowed favored contractors to pour into twelve inches of standing water.[276]

Hill himself would often personally show up on the job site to condemn materials which

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[272] "How Philadelphia Was Bled," *The Nation,* Vol. 81, No. 2094 (New York: 17 Aug 1905), 136f.
[273] The equivalent of approximately $4.1 million in 2022.
[274] The equivalent of approximately $18.3 million in 2022.
[275] The equivalent of approximately $5,200 in 2022.
[276] Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook,* courtesy of the Historical Society of Pennsylvania.

had already been approved and purchased. Dietrich would be forced to sell the material at a fraction of what he paid for it and purchase new material at full price. Materials condemned in this way would often be purchased at a steep discount by a favored contractor, such as McNichol, and used on a nearby job. Hill did the same with Dietrich's equipment. In a sworn affidavit, for example, Dietrich later testified:

> I started to do the concrete work, and before doing so I purchased two McKilvery concrete mixers, and had them delivered at Lardner's Point. The two mixers were seen by John W. Hill a number of times before I started to use them. He made no objections, and allowed me to use the mixers until they became second hand and it was impossible for me to return them to the McKilvery people. After they had been used for a short while, Mr. Hill condemned the two concrete mixers, and allowed me to furnish and set up a Chambers concrete mixing machine.
>
> This he allowed me to use until it became second hand, and then said the other contractors were complaining because he was allowing me to use a chambers machine, and that he would have to condemn it, and not allow me to use it any longer. On station No. 3, Ryan & Kelley's[277] job, John W. Hill allowed the use of the same make of machine. So he insisted that I get a cube mixer. I bought a cube mixer, set it up, and ran it for about three weeks. After that was second hand, he said, "Dietrich, you can mix your concrete by hand." These concrete machines cost me upward of $5,000[278] to set up. And all they are worth second hand is practically as old junk.[279]

Filtration Bureau Chief Hill's instructions to his inspectors was, "Keep after that Dutchman; you must nail him down to a hair."[280] One of them later testified that if anything,

[277] A favored contractor.
[278] The equivalent of approximately $172,000 in 2022.
[279] "How Philadelphia Was Bled, *The Nation*, Vol. 81, No. 2094 (New York: 17 Aug 1905), 137.
[280] "How Philadelphia Was Bled, *The Nation*, Vol. 81, No. 2094 (New York: 17 Aug 1905), 137.

Dietrich had understated his persecution. "In all my experience, I never knew of a contractor on a big operation to be so hampered, harassed, bullied, and annoyed as was Dietrich."[281]

The intimidation tactics worked. With creditors hounding him, Dietrich fled the city to avert financial ruin and avoid a nervous breakdown. He sublet his filtration construction job to a machine-connected company and eventually left Philadelphia for good.[282] Even after Dietrich went bankrupt, Hill attempted to assess him for $78,000 in overtime costs.[283]

Meanwhile McNichol was having his own challenges, if mostly of his own doing. He had been contracted by the Bureau of Filtration to build the Torresdale Conduit. At over $1.3 million,[284] it was not the largest of the filtration contracts but it was still one of juiciest of the plums.[285] Although the level of difficulty was much greater, the City's experience with McNichol's work on the conduit stands in contrast to that of its interaction with Dietrich.

The Torresdale Conduit[286] is a 2.6-mile-long tunnel designed to carry filtered water from the Torresdale Filtration Plant to the Lardner's Point Pumping Station for distribution throughout the city.[287] The Torresdale Plant on the north end and Lardner's Point on the south end are essentially at ground level; the conduit is situated a little over one hundred feet below ground and

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281 "How Philadelphia Was Bled, *The Nation*, Vol. 81, No. 2094 (New York: 17 Aug 1905), 137.
282 "How Philadelphia Was Bled, *The Nation*, Vol. 81, No. 2094 (New York: 17 Aug 1905), 137.
283 Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook*, courtesy of the Historical Society of Pennsylvania. The amount was the equivalent of approximately $2.6 million in 2022.
284 The equivalent of approximately $43.8 million in 2022.
285 Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 217. In fact, McNichol was given the largest job as well, the $5 million contract (the approximate equivalent of $168.3 million in 2022) to build the Torresdale Filtration Plant itself. See Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 218.
286 A thorough description of the Torresdale Conduit may be found at Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 247ff, and John W. Hill, *The Torresdale Conduit* (Philadelphia: 4 Feb 1905). The latter is a transcript of a presentation delivered by Hill to The Engineers' Club of Philadelphia; it can also be found at *Proceedings of The Engineers' Club of Philadelphia,* Vol. XXII, No. 2 (Philadelphia: Apr 1905).
287 The Torresdale Conduit is still in operational use today.

operates on the siphon principle. In order to keep air from disabling the siphon, the tunnel slopes up slightly from Torresdale to Lardner's Point. Even though the water within it flows from north to south, the tunnel was (perhaps counter-intuitively) 22 feet lower at the north end than at the south end.

The conduit was drilled and blasted out of bedrock. Eleven vertical construction shafts were dug and blasted down to the tunnel level. The shafts were numbered 1 through 11, beginning at the northern, Torresdale end. At the bottom of each shaft, excavation commenced in both directions simultaneously. The two shafts on the ends served as permanent connections to the other components of the system, the Torresdale Filtration Plant on the north and the Lardner's Point Pumping Station on the south. The nine shafts in between were closed and filled when the conduit was completed.

Over ninety percent of the 14-foot-wide tunnel was excavated through hard and stable rock such as hornblende and biotite gneiss. The remainder, mostly between Shafts 7 and 9, was through an unstable mixture of mica, mica schist, and clay. Workers in this area experienced numerous dangerous rock falls from the roof of the excavation and had to put up extensive timber shoring to allow the work to continue.

The conduit itself was constructed within the excavated tunnel. Circular in cross-section, it consisted of two courses of brick atop a concrete pad along the lower half and three courses of brick along the top half, with a finished interior diameter of ten feet, seven inches.[288] Where the roof of the excavation was particularly unstable, the upper brick work was increased to four and sometimes five courses of brick. The contract called for the entire space between the masonry

[288] Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 274. The interior diameter was originally designed to be ten feet, six inches, with a half-inch plaster surface all around, but the plaster would not adhere to the brick work where it was constantly wet from infiltrating groundwater. The design engineers decided to eliminate the plaster throughout the entire conduit, resulting in an increase in interior diameter of one inch.

and the rock face to be filled with concrete and the smaller spaces with grout.[289] The curved connections between the horizontal portion of the conduit and the vertical portions at either end were constructed of solid concrete. The facility was designed for a throughput of 300 million gallons per day.[290]

McNichol began work in January 1902 and finished in April 1904, over a year and a half behind the completion date specified in his contract.[291] The delay was mostly attributable to the work being much more difficult than had been anticipated.

Through stable rock, progress at the working faces was only a little over two feet per day. In difficult areas it slowed to a frustrating twelve inches and sometimes even six inches per day. In unstable areas, overhead rock falls required more timbering than was expected. Areas of unstable rock were accompanied by considerable groundwater intrusion. Water infiltration was so serious a problem that an airlock was employed on Shaft 2 for six weeks.[292]

Accidents were not uncommon. At 50 feet down, Shaft 4 was so heavily damaged in an accident that the engineers decided to abandon it and drop a replacement shaft approximately 100 feet south of the original.[293]

Supply issues were at times a problem. On a job that ultimately used 9.7 million bricks, difficulty obtaining sufficient quantities of acceptable quality sometimes slowed the work.[294] The job even managed to endure a coal shortage caused by a regional coal workers' strike. The usual double shift schedule had to be abandoned for a time when there wasn't enough coal to feed the

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[289] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 250.
[290] Bureau of Water, *Chief Engineer's 1901 Annual Report* (2 Jan 1902), 248; Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 243.
[291] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 241.
[292] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 242.
[293] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 242.
[294] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 243.

steam-powered equipment.[295]

One factor in the delay was caused by the Bureau of Filtration itself. When the first shaft reached its full depth, the design engineers decided to lower the tunnel an additional ten feet in the hopes of tunneling through more stable rock.[296]

Working conditions were dangerous. The tunnel was dark and claustrophobic. The pneumatic drills were noisy. Although air was supplied down to the tunnel by steam-driven air compressors, the air quality at depth was poor due to smoke, rock dust, and exhaled carbon dioxide. Rock falls were a constant threat. Safety accommodations were scant. Fourteen men lost their lives during the course of the construction.[297]

When the work was finally completed, the conduit was tested across ten days in mid-April 1904.[298] Problems were soon revealed. A relatively small amount of leakage was expected, but when the conduit was filled with water under pressure, it leaked far worse than was acceptable.[299]

All of the water had to be pumped out so that the conduit could be examined for possible causes. Four months were needed to arrange for the necessary equipment and get it into place.[300] The pumping out itself took over two months and was finished in October 1904.[301] With the pumping equipment needing to be kept in place in one of the shafts while the facility was being

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[295] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 242f.
[296] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 241.
[297] John W. Hill, *The Torresdale Conduit* (4 Feb 1905), 20. A survey of the causes of the fatalities shows one killed by drowning (in Pennypack Creek), one by rock fall in the tunnel, one by rock fall in a shaft, two by falling equipment in a shaft. One was crushed by equipment in a shaft, two were suffocated by blasting powder fumes in the tunnel, one was hit by rock shrapnel in the tunnel 400 feet away from a blast at one of the working faces, and one burned to death during a dynamite explosion in a storage shed. One man fell to his death when he was knocked down a shaft at the surface by a boom derrick. Three men being lifted out of one of the shafts in a hoisting bucket fell to their deaths when they were accidentally tipped out when the hoisting motor developed trouble and the bucket hit the lip of the top of the shaft.
[298] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 247.
[299] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 248.
[300] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 248.
[301] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 248, 250.

inspected, there was no room for a hoisting cage or even a bucket. Inspectors had to be lowered to the bottom one at a time in an open boatswain's chair.[302] The examination wasn't completed until the middle of December.[303]

The inspectors discovered that the majority of the leakage occurred where two construction sumps had not been closed and sealed prior to completion of the work.[304] It was an egregious and inexcusable oversight, not only on the part of McNichol's construction crew, but by also the inspectors at the Bureau of Filtration. The Bureau's inspectors had hounded Dietrich to despair but in an act of spectacular negligence they had not bothered to conduct a thorough examination of McNichol's work before approving final acceptance by the City. Although sealing the sumps would have been a routine prospect before construction wrapped up, it now required some tricky—and therefore expensive—work to accomplish.[305]

The examination also revealed that considerable debris had been left behind—dirt, sand, gravel, cement, loose brick, mortar leavings, and wood timbers and planks, two feet deep in at least one place and all found waterlogged after the tunnel had been pumped out. Even though the material was found in McNichol's area of responsibility, and the contract specifically required all such construction waste be cleaned out prior to handover to the City,[306] Bureau of Filtration Chief Engineer John W. Hill attempted to blame the mess on none other than George Dietrich,

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[302] Pronounced "BOE-zinz," a boatswain's chair is a horizontal board suspended by a slung rope, somewhat like a child's swing. Hardly a safe means of descent and ascent.
[303] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 249.
[304] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 250. Generally a sump is an opening or pit in a floor or other level area, into which water or other fluids can collect. In the conduit the sumps were large, unfinished openings in the masonry "floor" that allowed infiltrating water to be collected and pumped out during construction. Located at the bottom of each of the eleven shafts, the temporary openings were to be filled and sealed (using concrete and brick, similar to the general composition of the adjacent tunnel lining) at the completion of construction prior to withdrawal from the work site. The sumps at the bottom of Shafts 1 and 2, however, were left open and unfinished in error.
[305] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 250ff, 254f.
[306] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 254, 270f.

the unfortunate contractor he had already badgered into bankruptcy. Just plain mean, it was a cynical last stab at the honest contractor who never did back down but was no longer available to defend himself.[307]

It's probably fortunate that the sumps were forgotten; if the larger-than-expected leakage hadn't led to the emptying of the conduit, the debris would likely have damaged the pumps at Lardner's Point when operations began. At the very least, the conduit's carrying capacity would have been diminished and the engineers would have had no way of ascertaining the reason.[308]

In addition to the open sumps, the inspectors also found many small leaks in the masonry. In some places "considerable water flowed in" through open joints in the brick work.[309] The small leaks were closed with poplar plugs and white pine wedges. For the larger ones, holed were drilled through the brick and concrete, iron pipes were driven in, and grout consisting of a mixture of cement and fine sand was pumped into the voids behind the masonry under pressures of up to 100 pounds per square inch.[310] McNichol had earlier reported that all of the voids were filled during the original construction,[311] but obviously many were not.[312]

Bureau of Filtration Chief Engineer Hill estimated that had McNichol sealed the sumps properly and taken care of the other leaks prior to completing work, it would have cost the contractor no more than a thousand dollars. Instead, the rework cost McNichol over $20,000,[313] which he was forced to cover. For a $1.3 million job,[314] McNichol merely netted a $15,037

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[307] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 270; John W. Hill, *The Torresdale Conduit* (4 Feb 1905), 52.
[308] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 254, 270f.
[309] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 250, 254.
[310] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 254.
[311] Bureau of Filtration, *Chief Engineer's 1903 Annual Report* (31 Dec 1903), 274f.
[312] As McNichol watched his profit margin on this job evaporate, he cut corners on this rework and still did not fill all of the voids. See Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 165.
[313] The equivalent of approximately $688,800 in 2022.
[314] The equivalent of approximately $44.8 million in 2022.

profit,[315] only a little over 1.1 percent.[316]

As the corruption scandal began to break, in June 1905 Mayor Weaver fired Hill,[317] brought Webster over from the Bureau of Surveys to temporarily replace him, and in July appointed Gillette, Maclennan, and Parsons to examine the filtration contracts. By the end of July all of the contracts related to the construction of the Torresdale Filtration Plant had been suspended.[318]

As part of its work, the Board of Investigating Engineers took another look at the design and construction of the Torresdale Conduit. At the panel's recommendation the new Director of Public Works ordered the tunnel to again be emptied and inspected.[319] This time the pump-out only took a month, finishing two days before Christmas 1905.[320] The re-inspection began soon after.[321]

Despite the leak-plugging which had been done in 1904, the engineers still found water leaking into the conduit throughout its length, in places described as "spurting streams," at a rate of over 1.8 million gallons per day.[322] Declaring the facility "unfit for use," they recommended as a permanent fix a treatment similar to what was employed the first time but more systematically applied.[323]

Shortly after, on 28 Feb 1906, Mayor Weaver appointed Gillette Chief Engineer of the Bureau of Filtration, replacing Webster who had been filling the post temporarily while also

[315] The equivalent of approximately $517,900 in 2022.
[316] Bureau of Filtration, *Chief Engineer's 1904 Annual Report* (31 Dec 1904), 245, 254f.
[317] Recall that Weaver had, in the month prior, already fired Department of Public Works Chief Costello.
[318] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 155f.
[319] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 198.
[320] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 199; Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 48.
[321] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 198.
[322] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 165.
[323] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 164.

serving as Chief Engineer of the Bureau of Surveys.[324]

Meanwhile, the second series of repairs was now being implemented. At fifty-foot intervals along the entire length of the tunnel, four 2¾-inch holes were drilled through the masonry—one hole on either side at a point 45 degrees above horizontal and one on either side at 45 degrees below horizontal—using an electrically driven pneumatic drill powered by a dynamo at Lardner's Point. Grout was pumped through each of the holes into the voids and cavities behind the brick work until virtually all of the spaces between the masonry and rock face behind it had been filled.[325]

Not many voids were found below the lower half of the conduit, but above the upper brick work it was a different story. Even after the previous grouting there were still numerous large cavities remaining; some took "several hundred bags" of grout material each and one required 2,200 bags to completely fill.[326]

The ongoing repair work became a source of controversy. The pressure inside the conduit was higher than the hydrostatic pressure of the groundwater on the outside; leaks could be wasteful, but they would not affect the quality of the water since the direction of the leakage would be out, not in.[327] On the other hand, the conduit was essentially a barrel vault, or longitudinal arch. An arch is an engineering device which functions under compression, not tension. Higher pressure within the arch would tend to cause it to fail outward. There would need to be a downward, inward pressure, provided by the concrete in the outer voids, to counter the pressure within the conduit.[328]

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[324] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 155.
[325] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 164f.
[326] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 165.
[327] John C. Trautwine, Jr., "The Water Supply of Philadelphia," *The Journal of the Franklin Institute*, Vol. CLXVI, No. 5 (Philadelphia: The Franklin Institute, Nov 1908), 387f.
[328] Presumably, this was the reason the original contract called for the voids to be filled.

At any rate, Bureau of Filtration Chief Engineer Webster[329] and his successor Gillette[330] both thought the further repairs were needed, so they were pursued.[331] The work continued through 1906 and concluded in June 1907, at which point the conduit was recharged with water.[332]

Before the repairs were completed, however, Mayor Weaver's successor, John E. Reyburn, concluded that the filtration effort was becoming hopelessly bogged down under Gillette's leadership and fired him in May 1907. Reyburn appointed Fred C. Dunlap Chief Engineer of the Bureau of Filtration.[333] The drawn-out work on the conduit certainly contributed to Gillette's removal.

Five months later, Mayor Reyburn folded the Bureau of Filtration back into the Bureau of Water with Dunlap as Chief Engineer.[334] Dunlap considered the second round of repairs absurd and unnecessary, a waste of time, money, and effort. Worse, he thought it had the potential to harm the conduit. Dunlap commented in his first annual report:

> A very careful examination was made of the conduit and no defects whatever, either as to material or workmanship, could be discovered. The examination further disclosed the fact

[329] Bureau of Filtration, *Chief Engineer's 1905 Annual Report* (31 Dec 1905), 155. After firing Hill, Mayor Weaver appointed Bureau of Surveys Chief Engineer George S. Webster as temporary Acting Chief Engineer of the Bureau of Filtration in June 1905.
[330] Bureau of Filtration, *Chief Engineer's 1906 Annual Report* (31 Dec 1906), 155. Cassius E. Gillette had led Mayor Weaver's Board of Engineers which investigated the filtration contracts in 1905. Weaver appointed Gillette to succeed Webster as Chief Engineer of the Bureau of Filtration in February 1906.
[331] Incidentally, Trautwine, observing from the sidelines since 1900, came down on both sides of the issue. He worried that the blasting of rock necessary to close the two open sumps had the potential to damage the surrounding masonry, but was apparently satisfied that this had not occurred. He rather straddled the fence on the second round of leak-plugging; he considered it unnecessary but thought it improved the integrity of the conduit. See John W. Hill, *The Torresdale Conduit* (4 Feb 1905), 55, 57f; John C. Trautwine, Jr., "The Water Supply of Philadelphia," *The Journal of the Franklin Institute*, Vol. CLXVI, No. 5 (Philadelphia: The Franklin Institute, Nov 1908), 387f.
[332] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 48.
[333] John E. Reyburn, *First Annual Message* (6 Apr 1908), xxxi, included in Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908); Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 45f.
[334] Department of Public Works, *Directors 1907 Annual Report* (2 Jan 1908), 26, included in Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908); Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 46.

> that the so-called repairs were not repairs in any sense and of no benefit to the structure whatever; in fact, they would have caused serious damage had no the conduit been well constructed, and the fact that no damage was sustained is a fine testimonial to the superior quality of the material and workmanship of this structure. The cost of this unnecessary work was $184,301.27,[335] from which the city obtained no benefit whatever.[336]

Were repairs to the conduit necessary? The first round certainly was. The failure to close two of the sumps and the debris left inside was unforgivable. Uncorrected, the successful operation of the filtration system would have been jeopardized. McNichol's crews also did not completely fill the voids behind the masonry with grout as was called for in the contract. In some places, the conduit leaked like the proverbial sieve. There would have been some degree of wasting of filtered water, even if the sumps had been properly closed.

What is less certain is whether or not the second round of repairs was necessary. Looking back more than a hundred years later, it is hard to tell. After the initial grouting, numerous voids still hadn't been filled and there remained a good deal of leakage. When operational, though, the conduit would have leaked out, not in, so water quality would not have be affected, but there would still have been some wastage. How much, however, is difficult to determine. Packing virtually all of the voids, though, probably did serve to strengthen the conduit against the outward pressure it experienced during operational use.

What is undisputable is that one of the effects of the corrupt machine politics was to make everything cost more and take longer than it should have. With the scandal over the massive handout to favored contractors, it didn't take much for the public to lose confidence in the work, at least temporarily. To be sure, the filtration system in Philadelphia was the largest

[335] The equivalent of approximately $5.8 million in 2022.
[336] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 48f.

undertaking of its kind up to that time. But as reformer Rudolph Blankenburg pointed out in 1905, while filtration plants in other cities had been constructed for less than five percent over their project costs, in the three-year period from mid-1902 to mid-1905 the Bureau of Filtration saw a 100 percent cost overrun yet had only a fraction of the necessary operational filtration capability to show for it. Capacity for capacity, the systems in Philadelphia were costing twice what those in other cities were to construct.[337] And the system still wasn't near being completed.[338]

This was no mere exercise; while the machine fiddled, people continued to needlessly die.[339] As filtration began to be implemented at the pumping stations on the Schuylkill River, the threat of typhoid was reduced but not eliminated. An outbreak occurred in 1906 in areas not receiving filtered water, the very areas the delayed Torresdale Filtration Plant would have served. The mortality rate increased over 52% over the previous year, to 73.8 deaths per 100,000 residents, one of the worst in 25 years.[340] (Refer to Figure 10-1, Mortality Rate from Typhoid Fever in Philadelphia, 1860–1936.) It was yet another reminder of what was at stake.

The leaders of the machine, however, served only themselves and their associates; they were callously indifferent to the human suffering around them. As Rudolph Blankenburg wrote in 1905:

> When we consider that thousands of homes were at that time invaded by dread diseases

[337] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena*, Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 579.
[338] As it turns out, in terms of the overall time from the beginning of construction to the achievement of total filtration of the city's entire water supply, it was at the halfway point at best.
[339] In the final paragraphs of their 1905 report, Gillette and Maclennan estimated that at least 1,200 people unnecessarily died from typhoid during just one year's delay in the completion of the Torresdale Filtration Plan. See Cassius E. Gillette and John D. Maclennan, *Report of Board of Investigating Engineers* (28 Oct 1905), published in "The Major and Mr. Maclennan Put Their Names to Document Alleging That City Has Been Swindled by Collusion of Contractors and That Defective Work on Plants Is Revealed," *Public Ledger* (30 Oct 1905), collected in *Durham Scrapbook*, courtesy of the Historical Society of Pennsylvania.
[340] Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987), 85.

> that traced their origin to the polluted waters we were compelled to use, that hundreds and hundreds of families were made desolate by the taking away of dear and loved ones from typhoid and diphtheria, it appears incomprehensible how any body of men, with even the slightest instinct of humanity, could be so cruel, so unnatural, so diabolical, as to delay the construction of filtration plants that were to bring relief and save life, for the sake of placing the contracts in favored hands.[341]

Mayor Weaver's investigation did have an effect, however. Although the majority of payments on some of the contracts had already been made and all of the suspended construction jobs were eventually re-awarded to the original contractors by court-appointed arbiters, construction companies favored by the machine received virtually no additional contracts for the remainder of the filtration construction program.[342]

In any event, of the repair work on the conduit, necessary or not, was concluded on 12 June 1907,[343] a month and a half after Mayor John E. Reyburn, Weaver's successor, took office, and the Torresdale Filtration Plant began partial operations three weeks later, on Independence Day 1907.[344] By the end of 1908 the percentage of the city's water supply being filtered rose to 56 percent as more capacity at Torresdale came online.[345] On 9 Feb 1909 the Torresdale filtration plant became fully operational.[346]

The only unfiltered water now came from the Fairmount, Spring Garden, and Queen

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[341] Rudolph Blankenburg, "Forty Years In the Wilderness: Municipal Black Plague, Light In the Midst of the Darkness," *The Arena,* Vol. XXXIII, No. 187 (The Brandt Press: Trenton, Jun 1905), 577. Blankenburg would eventually serve as mayor from 1911 to 1916.

[342] Bureau of Water, *Chief Engineer's 1908 Annual Report* (1 Jan 1909), 67ff.

[343] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 48. In the end, an extremely robust conduit was achieved and the facility has stood the test of time. Still operating, the Torresdale Conduit remains today a key component of Philadelphia's water supply system.

[344] Bureau of Water, *Chief Engineer's 1907 Annual Report* (25 Jan 1908), 111.

[345] Bureau of Water, *Chief Engineer's 1908 Annual Report* (1 Jan 1909), 30f.

[346] Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 48; Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 49. The Annual Report for 1909 states that the Torresdale Filtration Plant became fully operational when the preliminary filters were completed on 9 Feb 1909. The Annual Report for 1911 states that the preliminary filters began operational service on 21 Jan 1909.

Lane Works.[347]

Nine days later, on Thursday 18 February 1909, the Fairmount Water Works virtually shut down.[348] All but Wheel No. 1 (the 1851 test turbine)[349] ceased operations and the facility stopped serving residential customers. Wheel No. 1 and the Fairmount Reservoir continued to serve a single industrial customer[350] until 16 Mar 1911 when all operations ceased entirely.[351] On that date the Fairmount Water Works was transferred to the Department of the Mayor.[352] On 10 Apr the Fairmount Reservoir was turned over to the Fairmount Park Commission for the construction of a "public Art Gallery.[353]

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347 When the Queen Lane Station was shut down on 1 May 1909, an entirely filtered water supply for the citizens of Philadelphia was initially achieved. Within weeks, however, it was determined that the Lardner's Point Pumping Station could not adequately deliver filtered water from the Torresdale Filtration Plant to the elevated portions of northwest Philadelphia formerly supplied by the Queen Lane Station and Reservoir. The Queen Lane Station was re-activated on 4 Jun 1909 and temporarily pumped raw Schuylkill River water into the system while an additional filtration plant was designed and constructed at the Queen Lane Reservoir. When this facility became operational on 29 November 1911, city-wide filtration was made permanent. The effect on the typhoid mortality rate was marked. In 1905 it was 48.3 deaths per 100,000 population. By 1909 the rate had dropped to 21.8 and in 1912 the rate was 12.6, the lowest ever seen in the city. By December 1915, it had dropped to 7. See Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 18f, 48f, 78; Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 10, 20.

348 Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 48, 57. The Spring Garden Station was also shut down on this date.

349 Recall that Wheel 1 pumped exclusively to the Fairmount Reservoir.

350 Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 57.

351 Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 36. The station's seven turbines pumped a total of 1,018,742,639 gallons in 1909. The single turbine pumped 180,977,997 gallons in 1910 and 31,803,007 gallons in 1911. See Bureau of Water, *Chief Engineer's 1909 Annual Report* (3 Jan 1910), 57, 69; Bureau of Water, *Chief Engineer's 1910 Annual Report* (1 Jan 1911), 65; Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 40.

352 "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 598ff. Signed by Mayor John E. Reyburn on 16 Mar 1911, the ordinance transferred "the buildings known as the Fairmount Water Works in Fairmount Park, the standpipe or water tower" from the Department of Public Works, Bureau of Water, to "the Department of the Mayor." See also Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9.

353 *Journal of the Select Council of the City of Philadelphia, from 1911,* 127f; Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9. The ordinance transferred "all that tract or plot of ground known as the Fairmount Reservoir…and belonging to the City of Philadelphia and used by the Department of Public Works, (Bureau of Water)" to "the Commissioners of Fairmount Park, for the use of the City of Philadelphia as a site for a public Art Gallery…" See also "The Application of Lewis Nixon, Sr., Louis S Levy and Paul M Hahn, as Executors of the Last Will and Testament of Emma T. Gary: Selected Laws, Ordinances and Regulations relating to Fairmount Park and other Parks under the control of the Fairmount Park Commission," *Court of Appeals of the State of New York* (10 Jul 1935), 257f.

The great turbines were stilled for the last time, silenced for good. Where for 87 years the sounds of rushing water, turning breast wheels, whirring turbines, and working men could be heard, there was now only silence.

The Fairmount Water Works, as a water pumping facility, was no more.

CHAPTER 11

CREATION OF THE AQUARIUM

In reality, the Fairmount Water Works' glory days were over long before it was shut down. The heady days of being a technological marvel were long since gone by the time it was shuttered. Because of constraining circumstances and changes in technology, it had reached the end of its useful service life, much like the Schuylkill and Centre Square Works some ninety years before. Unlike its prototype, however, Fairmount happily was not demolished, at least not entirely.

The Fairmount Water Works' serviceability as a water pumping facility may have passed, but the beautiful grounds still drew visitors. Because it had for so long been a unique treasure to Philadelphians, there was a desire to find a new use for the facility.

A public aquarium had been proposed as early as 1874,[1] just as the Zoölogical Society of Philadelphia was getting ready to open the Philadelphia Zoölogical Gardens[2] for the first time, but the idea failed to gain support at the time. It wasn't until just after the turn of the twentieth century that such an attraction would become a natural outgrowth of a combination of public interest and municipal support.

Interest in aquariums and fish life began to develop in the United States in the 1890s. Marshall McDonald, United States Commissioner of Fish and Fisheries from 1888 to 1895 and pioneer of inland salt-water aquariums, organized a large aquarium exhibit for the landmark Columbian Exposition in Chicago in 1893. The Fisheries Building featured displays of fish

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[1] "Editorial," *Philadelphia Inquirer* (18 Mar 1974), 4.
[2] The formal name of the Philadelphia Zoo.

species from numerous states and countries.

Philadelphia Common Councilman Thomas Meehan, notorious for opposing filtration funding in the 1890s, was also a prominent member of Philadelphia's Academy of Natural Sciences and helped secure funding from the state legislature for participation by Pennsylvania. Pennsylvania Commissioner of Fisheries William E. Meehan, Thomas' son, mounted an impressive exhibit in a 1,701-square-foot pie-shaped slice of the circular western extension of the Fisheries Building.

Visitors entered at the point of the wedge through a keystone-crowned archway, labeled "Pennsylvania Fish Commission," and were greeted by a large, horseshoe-shaped, simulated grotto. The tunnel-like walls and ceilings were faced in oak and hemlock bark, cork, and gnarled laurel roots, and contained pockets of mosses and brightly colored plants. Embedded in the rustic walls were twenty display tanks of various sizes, the largest of which was six feet long, three feet high, and three feet deep. While not large by today's standards, they were sizable for the time and featured native Pennsylvania species such as rock sturgeon, pike-perch, yellow perch, blue pike, yellow catfish, various types of bass, muskellunge, and freshwater eels, swimming and interacting in something approximating their natural habitats. In the central area a cascade of water fed a pool containing trout. Other displays included models of a few of the state's hatchery operations and numerous framed photographs.

Commissioner Meehan used the Pennsylvania Fish Commission's custom-built rail car, the "Susquehanna," to transport live specimens to the fair. The Pennsylvania exhibit was awarded 74 Grand Prize Medals, 187 Gold Medals, 135 Silver Medals, and 106 Bronze Medals.[3]

[3] *Catalogue of the Exhibits of the State of Pennsylvania and of Pennsylvanians at the World's Columbian Exposition* (Harrisburg: Clarence M. Busch, 31 Jul 1893), 44aff; *Plans and Diagrams of All Exhibit Buildings in the World's Columbian Exposition* (Chicago: W. B. Conkey Co., 1893), 12ff; Jay Osman, "Meet Me at the Fair," *Pennsylvania*

In 1904, Meehan organized a similar exhibit for the St. Louis World's Fair, this time occupying 4,000 square feet of exhibit space, featuring 35 display tanks, and even exhibiting a dolphin that had been captured in the Delaware River.[4]

Following the fair in St. Louis, in April 1905 the state legislature donated all of the exhibit's display tanks and mounted specimens to the City of Philadelphia for use in some sort of as-yet-undefined aquarium display. The tanks were stored at the Philadelphia Zoo and the mounted specimens were sent to the Academy of Natural Sciences. The state legislature also authorized the Commissioner of Fisheries to donate live fish.[5]

Back home, an aquarium exhibition held in Fairmount Park's Horticultural Hall in 1900 displayed numerous varieties of goldfish and stimulated local public interest in aquatic life.[6] Within a few years, local newspapers were filled with advertisements for aquaria and various types of fish.[7]

On 16 Mar 1911 Mayor John E. Reyburn signed into law an ordinance from City Councils which transferred the buildings of the Fairmount Water Works—including the Standpipe and ascending mains, but not the Fairmount Reservoir—from the Bureau of Water (under the Department of Public Works) to the Department of the Mayor. The primary purpose of the legislation was the creation of "a public aquarium and museum for the pleasure of the

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Angler & Boater, Vol. 67, No. 6 (Pennsylvania Fish and Boat Commission, Nov/Dec 1998), 20f; Jay Osman and Tim Klinger, "'Susquehanna,' Pride of the Fish Commission," *Pennsylvania Angler & Boater,* Vol. 67, No. 5 (Pennsylvania Fish and Boat Commission, Sep/Oct 1998), 35f.

4 Jay Osman, "Meet Me at the Fair," *Pennsylvania Angler & Boater,* Vol. 67, No. 6 (Pennsylvania Fish and Boat Commission, Nov/Dec 1998), 22f.

5 "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 599. The state legislature's joint resolution of 2 Apr 1905, donating the materiel, is quoted in the ordinance. See also William E. Meehan, Director of Public Aquarium, to Cyrus D. Foss, Secretary to the Mayor (13 Jan 1912); Meehan to Nathan R. Buller, Pennsylvania Commissioner of Fisheries (13 Jan 1912).

6 Leighton R. Taylor, *Aquariums: Windows to Nature* (Prentice Hall, 1993).

7 For example *Philadelphia Inquirer* (24 Aug 1910), 24; *Philadelphia Inquirer* (9 Oct 1910), 28; *Philadelphia Inquirer* (28 Jan 1912), 27; *Philadelphia Inquirer* (13 Nov 1913), 35.

people and instruction in the life history of aquatic animals." The ordinance authorized the mayor to sell all of the turbines, pumps, and equipment—except Turbine 1 and its machinery—in order to kick-start the facility's funding.[8]

A secondary aim of the ordinance was "that the beautiful buildings, together with the standpipe or water tower, be preserved for all time as a fine example of the earlier architecture and methods of supplying water to the people of Philadelphia."[9] The aquarium would be an early example of intentional adaptive reuse, in which a site significant for its history, architecture, or engineering would be preserved by repurposing it.

Included in the legislation was language formally inviting Commissioner of Fisheries Meehan to lead the planning and implementation of the aquarium under the mayor's oversight, and to become its director when it was opened.

Son of the late Common Councilman Thomas Meehan,[10] William E. Meehan (31 Aug 1853–2 Jan 1930)[11] grew up surrounded by horticulture and scientific inquiry. A published author by his teens, in his twenties he became a reporter and editor for Philadelphia's *Public*

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[8] "An Ordinance to provide for the William E. construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 598ff. A proposal, floated later in the year, to convert the Fairmount Water Works into a hydroelectric plant to provide power and light for Fairmount Park facilities was considered by the mayor but ultimately rejected. See "Mystery Hangs Over City Hall," *Philadelphia Inquirer* (19 Sep 1911), 2; "Urges Converting of Water-Works Into Power Plant," *Philadelphia Inquirer* (24 Sep 1911), 15.

[9] "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 598ff. The mayor signed the ordinance on 16 Mar. See (prob.) *Journal of the Select Council of the City of Philadelphia,* from the same period, 44ff (in author-editor's possession). See also Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9. It is difficult to determine the precise location of the boundary line of the "Aquarium property," but it seems to have been just above the Distribution Arch, Standpipe, and Cliffside Paths. See also Meehan to Allan Corson, Chief Engineer of Fairmount Park Commission (4 Jul 1919). A supporting document for a 1978 proposal for a Water Department headquarters building at Fairmount indicates the property line at or near the base of the Cliffside Paths. See *Plot Plan of Fairmount Waterworks Complex,* blueprint (Design Branch, Philadelphia Water Department, 11 Jul 1977), collection of Philadelphia Water Department Historical Archives.

[10] Councilman Thomas Meehan had died in 1901.

[11] "Obituary: William E. Meehan," *Philadelphia Inquirer* (4 Jan 1930), 5; Daniel Shaw, "William E. Meehan: An AFS Legacy Builder," *Fisheries* (Taylor & Francis, for American Fisheries Society, 4 Aug 2020), 427ff. Shaw is Meehan's great-great-grandson.

Ledger, reporting on topics in the sciences, education, and local government while running his own cut flowers business. Meehan participated in 1892 as the expedition botanist for the successful retrieval party for Robert Peary's unsuccessful expedition to the North Pole.[12] Pennsylvania Fish Commissioner Henry C. Ford chose him to be his assistant in the early 1890s and he wrote the visitors' guide for the Commonwealth's popular fish exhibit at the Columbian Exposition in Chicago.[13] In 1896 he became the Fish Commission's secretary and statistician.

A prominent advocate of pisciculture and the conservation of waterways, Meehan was a member of the Academy of Natural Sciences and a member and president of the American Fisheries Society. Active at the local level as well, he was elected to the Philadelphia School Board, filling the seat vacated by his father upon the elder Meehan's death in 1901. He was known for his promotion of education for African Americans.

When the Pennsylvania legislature replaced the state's Fish Commission with the Fisheries Commission in 1903, Governor Samuel Pennypacker appointed Meehan to head the new organization. A year later Meehan personally organized Pennsylvania's live fisheries exhibit at the St. Louis World's Fair. The popularity of the exhibit convinced Meehan that the state could successfully mount a permanent aquarium attraction and he began to advocate for it. The tanks used in St. Louis could easily form the core of such an exhibit.

As Pennsylvania Fisheries Commissioner, Meehan had worked behind the scenes with Mayor Reyburn and City Councils to draft and pass the ordinance creating Philadelphia's public aquarium.[14] In August 1911, he resigned his state post to actively stand up the new facility and

[12] Peary's attempt failed that year, but the team had overwintered in the Arctic and was feared lost. Peary subsequently succeeded in reaching the North Pole in 1909, although his claim remains controversial.
[13] William E. Meehan, *Fish, Fishing and Fisheries of Pennsylvania* (Harrisburg: E. K. Meyers, 1893).
[14] William E. Meehan, Pennsylvania Commissioner of Fisheries, to Edward J. Nolan, Academy of Natural Science (13 Dec 1905).

become the Aquarium's first director.[15] He would serve as director until his death in 1930.

In a further disposition of the property of the Fairmount Water Works, City Councils' on 10 Apr 1911 passed an ordinance transferring the area of the Fairmount Reservoir from the Bureau of Water to the Fairmount Park Commission for the construction of a "public Art Gallery." The ordinance also dedicated $200,000[16] toward the museum's construction.[17]

Mayor Reyburn had supported the development of the aquarium during his tenure. On 7 Nov 1911, however, independent reform candidate Rudolph Blankenburg won the mayoral election and would take office on 4 Dec.[18] Blankenburg was dedicated to rooting out corruption and trimming expenses. He expressed little interest in the municipal aquarium; it was an expense he did not desire.

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[15] Mayor Reyburn would not get around to formally appointing Meehan the Aquarium's director until 1 Dec 1911, a full week after the Aquarium opened to the public. See John E. Reyburn, Mayor of the City of Philadelphia, to William E. Meehan (1 Dec 1911). In the same letter of appointment, the mayor set Meehan's annual salary at $4,000 and appointed four staff members with an annual salary of $900 each. See also Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (8 Mar 1912); Meehan to Witmer Stone, Academy of Natural Sciences (27 Sep 1913); and Meehan to James D. Shea, Deputy Commissioner of the Boston Parks and Recreation Department (29 Jan 1914). The mayor's specification of a salary for Meehan may have been in contravention of the language of the Aquarium's enabling ordinance of 16 Feb 1911: "…the said William E. Meehan, Commissioner of Fisheries, shall be requested to oversee and manage the said aquarium and museum subject to the approval of the Department of the Mayor, until it is completed, but he shall not be considered an employee of the city of Philadelphia or receive any salary." See "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 600. Perhaps the enabling ordinance was interpreted as prohibiting a salary for Meehan until the completion of the Aquarium and allowing one afterward.

[16] The equivalent of approximately $6.2 million in 2022.

[17] *Journal of the Select Council of the City of Philadelphia, from 1911,* 127f; Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9. The ordinance transferred "all that tract or plot of ground known as the Fairmount Reservoir…and belonging to the City of Philadelphia and used by the Department of Public Works, (Bureau of Water)" to "the Commissioners of Fairmount Park, for the use of the City of Philadelphia as a site for a public Art Gallery…" The ordinance also appropriated $200,000 (the equivalent of $6 million in 2022) for construction of the museum and identified the source of the funds as an $11.2 million loan Councils had authorized on 17 Jun 1898. See also "Application of Lewis Nixon, Sr., Louis S Levy and Paul M Hahn, as Executors of the Last Will and Testament of Emma T. Gary: Selected Laws, Ordinances and Regulations relating to Fairmount Park and other Parks under the control of the Fairmount Park Commission," *Court of Appeals of the State of New York* (New York: Court Press, 10 Jul 1935), 257f.

[18] Under the Bullet Bill, mayoral elections had occurred on the second Tuesday in October and the mayoral term began on the first Monday of the following April. Changes to the city charter moved the 1911 and succeeding mayoral elections to the first Tuesday in November. The first mayoral term after the change (Blankenburg's) began on the first Monday of December 1911. Succeeding mayoral terms began on the first Monday in January following the election. Throughout, mayors were not allowed to succeed themselves; Mayor Reyburn was not eligible for re-election.

With the mayor-elect's signal priorities, there was no telling how he might slow-walk the development of the aquarium, perhaps even finding a way to kill it outright. If there were to be an aquarium at all, construction would need to begin as soon as possible. An initial facility would need to be up and running in the Engine House prior to the 4 Dec inauguration, if only to have a temporary setup as a stake in the ground.[19]

On 8 Nov Meehan collected from their storage at the zoo the display tanks which had been used in the state's exhibit at the St. Louis World's Fair in 1904 and had been donated to the City by the Commonwealth in 1905.[20] Despite an almost complete lack of money—the Bureau of Water intended to advance to the mayor $1,500[21] in anticipation of selling the turbines and pumps for scrap, but had not yet done so[22]—construction got under way in the Engine House on 13 Nov.[23] The Pennsylvania State Fish and Game Commission and Forestry Protective Association guaranteed the cost of lumber. Various City agencies loaned construction workers.

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[19] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 3. The description emphasizes the "temporary" nature of the initial operation, using this precise vocabulary.

[20] William E. Meehan, Director of Public Aquarium, to Cyrus D. Foss, Secretary to the Mayor (13 Jan 1912); Meehan to Nathan R. Buller, Pennsylvania Commissioner of Fisheries (13 Jan 1912); Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911). In 1905, while he was the state Commissioner of Fisheries, Meehan had 34 tanks from the St. Louis exhibition stored at the zoo and the exhibit's mounted specimens stored at Philadelphia's Academy of Natural Sciences. Of the 34 tanks, one, a small four-foot-long slate tank, was broken beyond repair during shipment from St. Louis. The glass of ten of the largest tanks, which were intended to be used when the Aquarium expanded beyond the Engine House, was broken by zoo attendants during handling and had to be replaced by the City of Philadelphia. The mounted specimens were improperly stored "in the basement of the Academy of Natural Sciences" and by 1912 had sufficiently deteriorated that they were no longer fit for display.

[21] The equivalent of approximately $46,800 million in 2022.

[22] Meehan to Miss M. E. Kane, Philadelphia (8 Feb 1912); Frederick C. Dunlap, Chief of the Bureau of Water, to Rudolph Blankenburg, Mayor of the City of Philadelphia (21 Feb 1912). "There was only a very small sum of money in sight ($1,500)," Meehan wrote in his 8 Feb 1912 correspondence to Kane, "and even that was not available on November 13th when the actual work of construction was begun." The aquarium would not receive the $1,500 until 1 Dec 1911. See Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (8 Mar 1912). Thus from the Aquarium's inception began a familiar and perpetual problem which would afflict it throughout its entire history—chronic underfunding. See William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.

[23] William E. Meehan, Director of Public Aquarium, to Rudolph Blankenburg, Mayor of Philadelphia (30 Dec 1911); William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4. Aquarium opened Thanksgiving Day, 24 Nov 1911. Construction began 13 Nov 1911; Aquarium opened on Thanksgiving Day despite construction not yet completed.

An extensive system of pipes and other supporting infrastructure was also installed. The Electrical Bureau installed the lighting system.[24]

Meehan himself pitched in to help install 19 of the smaller display tanks[25] in the 50 by 40-foot main room. Seventeen of them—variously measuring four, five, and six feet long—were placed along the north, west, and south sides of the former refreshment saloon.[26] Meehan placed two six-foot-long tanks on tables in the middle of the room. In the lower level of the Engine House a large storage tank for fresh water was constructed. A storage tank for salt water was built in the former pump room under the Engine House deck. The sole surviving turbine, located in the lower level between the Engine House and the Old Mill House, was pressed into service to pump water from the Schuylkill River up to the Fairmount Reservoir for use in the freshwater exhibit tanks.[27] In three weeks' time Meehan and his team converted the first-floor main hall into an exhibition area and lecture hall.[28]

Despite ongoing construction,[29] the much anticipated[30] attraction had a soft opening under the name "Public Aquarium and Museum"[31] on Thanksgiving Day, Thursday 23 Nov

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[24] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 3f.
[25] Meehan to Miss M. E. Kane, Philadelphia (8 Feb 1912).
[26] "Collection of Finny Curiosities Adds to Fairmount Park's Treasures," *Philadelphia Inquirer* (26 Nov 1911), 21.
[27] This can be inferred from references to the turbine breaking down in September 1913, at which time the Aquarium switched from river water to municipal water for its freshwater exhibits. See Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914).
[28] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 3f. The Aquarium was opened with 19 display tanks in the Engine House. See also Meehan to Superintendent of Brighton Aquarium, England (11 Jan 1915).
[29] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Meehan to Kane (8 Feb 1912). The tanks would not be electrically lighted until 1 Dec, eight days after opening day. Meehan reported to the mayor that "although the work of construction was not completed, I yielded to the entreaties of people and opened the doors to the public." Meehan wrote to Kane, "the tanks [were] electrically lighted on December 1st, 1911."
[30] "Mayor Reyburn Approves Plan for Conversion of Fairmount Water Works," *Philadelphia Inquirer* (25 May 1910), 3; "To Begin City Aquarium," *Philadelphia Inquirer* (8 Oct 1911), 7.
[31] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4. Meehan's letterhead from this time, however, all bear the shorter name, "Public Aquarium." See Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (16 Dec 1911); Meehan to

1911,[32] eleven days before the end of Mayor Reyburn's administration. This was followed by an official opening at nine o'clock in the morning on Saturday 25 Nov.[33] The first admissions on Saturday were two excited 13-year-old boys, Richard Riemer and William Geiger from Ogden Street in the nearby Fairmount neighborhood, who ran in as soon as the doors were opened. The first adult was T. W. McCall, of 1326 Pine Street, who arrived a few minutes later.[34]

Altogether, "seventeen species of fish found in the waters of Pennsylvania" were on display, including sturgeon, catfish, bass, yellow perch, pike-perch, sunfish, salmon, pickerel, minnows, eel, and goldfish (carp).[35] One notable specimen was a pink-eyed albino catfish caught in the Delaware River just a week earlier.[36] By the end of the year, the number of species reached 25, not including 24 types of fancy goldfish. In January 1912 three "albino lake trout" were donated by the New York Aquarium.[37]

There were also aquatic reptiles and amphibians—including alligators from Florida, snapping turtles, terrapin, and frogs—and a collection of freshwater crayfish.[38] A hatchery which demonstrated the process of raising brook trout, rainbow trout, shad, and other fish was created

Blankenburg (19 Dec 1911); and Meehan to O'Mara Bros. (12 Feb 1912); Meehan to Miss M. E. Kane, Philadelphia (8 Feb 1912), in which Meehan refers in the body of the letter to "The Public Aquarium, which is the official title."

32 "Public Aquarium Already Excites Unusual Interest," *Philadelphia Inquirer* (26 Nov 1911), 21; William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4. The 1929 souvenir booklet incorrectly lists the date of Thanksgiving in 1911 as 24 Nov.

33 "City Aquarium is Open to Public," *Evening Bulletin* (26 Nov 1911).

34 "City Aquarium is Open to Public," *Evening Bulletin* (26 Nov 1911).

35 Meehan to Kane (8 Feb 1912).

36 "Open City Aquarium," *Evening Bulletin* (25 Nov 1911).

37 Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (3 Feb 1912). Opened in 1896, the New York Aquarium was at this time housed in Castle Clinton, a former harbor defense facility located in Battery Park on the southern tip of Manhattan. See "History of the New York Aquarium," *New York City Department of Parks & Recreation* (2021), <www.nycgovparks.org/about/history/zoos/ny-aquarium>, accessed 6 Dec 2021.

38 Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Meehan to Kane (8 Feb 1912). The alligators, which must have been very young and therefore small, were kept with the other reptiles in one of the tabletop tanks in the center of the great hall. The other tabletop tank contained the goldfish.

in the Caretaker's House, one of the buildings atop the deck of the Old Mill House.[39] The majority of the specimens were provided by state hatcheries, including the one in the Torresdale neighborhood of northeast Philadelphia,[40] but many were donated by private citizens. By February of 1912, the hatchery population numbered over 13,000.[41]

In the three remaining buildings on the Old Mill House deck, Meehan set up a few support functions—a paint shop in the South Entrance House, a carpentry shop in the North Entrance House,[42] and an executive office in the Watering Committee Building.[43] Except for the hatchery, the exhibit area was limited to the Engine House because the work of removing the turbines, pumps, and associated machinery from the Old Mill House and New Mill House had not yet been finished.[44]

The entire Aquarium was free to the public and was open seven days a week. The hours were initially from 8:30 a.m. to 4:45 p.m.[45] A course of lectures on "Fish Life" was offered on Wednesday evenings beginning 20 Dec; Meehan himself taught the course initially before

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[39] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (16 Dec 1911); Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9; Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914); *Fairmount Park Aquarium* (1929), 4. Within a few months, enough trout had been raised to enable distribution to streams around the Philadelphia area. See Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (3 Feb 1912).

[40] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.

[41] "13,000 Trout at Aquarium," *Philadelphia Inquirer (*19 Feb 1912), 11.

[42] Hand-drawn diagram attached to Engineer's Report, Fairmount Park Aquarium (18 Nov 1917).

[43] Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914); Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission (12 Jan 1915). His own office was not high on Meehan's list of priorities. Until 1915, he and his assistant used two battered old desks left over from the Bureau Water days. Meehan's chair had been repaired so many times it had become a danger to use. Even the floorboards were still bare. See Meehan to Walter Q. Thomas, Belmont Office of Fairmount Park Commission (20 May 1915). See also Hand-drawn diagram attached to Engineer's Report, Fairmount Park Aquarium (18 Nov 1917).

[44] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911).

[45] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Meehan to Kane (8 Feb 1912). The hours were modified in 1915 to: Mondays through Saturdays, 9:00 a.m. to 5:00 p.m.; Sundays, 9:00 a.m. to 6:00 p.m. See "NOTICE," attached to Meehan to C. H. Townsend, New York Municipal Aquarium (19 Mar 1915). The winter hours typically differed slightly: Mondays through Saturdays (and holidays), 9:00 a.m. to 4:30 p.m.; Sundays, 9:00 a.m. to 5:00 p.m. See "NOTICE," Meehan (30 Sep 1915); William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance*, souvenir booklet (Fairmount Park Commission, 1929), 9.

arranging for a series of guest lecturers.[46]

Although the proverbial paint had yet to dry, the Aquarium was an immediate hit. Favorable reviews in the local press undoubtedly contributed to its popularity.[47] Some 700 people visited on opening day. The Sunday after, 7,500 showed up.[48] On Thanksgiving, a week after opening, approximately 3,500 stopped by.[49] On Sunday 10 Dec there were 10,788 visitors and “several thousand more” were turned away.[50] By the end of the year 38 days later, cumulative attendance topped 46,000. The total attendance for 1912, the first full year of operation, was 266,448.[51]

A local newspaper related a curious incident which took place toward the end of December, just a few weeks after opening. A five-foot-long eel, nearly three inches in diameter, swam in from the Schuylkill River and got itself wedged inside the supply line to the Aquarium, completely blocking the supply of water. It must have entered through the Forebay, been taken up through the turbine and pump without harm, and thrown up to the Fairmount Reservoir, after which it got stuck in the narrow supply line coming back down. Unfortunately, Aquarium staff could not extricate the animal from the line without killing and dismembering it.[52]

Meehan estimated the Aquarium would need $30,000 for the year 1912.[53] Of this amount, $17,240 would be dedicated to salaries,[54] and $1,260 to maintenance and operating expenses.[55] Meehan thought the creation of a saltwater exhibit hall in the New Mill House could be achieved

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[46] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); “Five Foot Eel Stops Aquarium Water Supply,” *Philadelphia Inquirer* (31 Dec 1911), 1.
[47] “Public Aquarium Already Excites Unusual Interest,” *Philadelphia Inquirer* (26 Nov 1911), 21.
[48] “3500 Persons Visit New Park Aquarium,” *Philadelphia Inquirer* (1 Dec 1911), 6.
[49] “3500 Persons Visit New Park Aquarium,” *Philadelphia Inquirer* (1 Dec 1911), 6.
[50] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911).
[51] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9.
[52] “Five Foot Eel Stops Aquarium Water Supply,” *Philadelphia Inquirer* (31 Dec 1911), 1.
[53] The equivalent of approximately $935,300 in 2022.
[54] The equivalent of approximately $537,500 in 2022.
[55] The equivalent of approximately $39,300 million in 2022.

for $11,500.[56] His ultimate plans for expansion included a freshwater exhibit hall in the Old Mill House. In total, Meehan envisioned 35 tanks and three pools in the New Mill House, 70 tanks and eight pools in the Old Mill House, 50 tanks in the Engine House, and an outdoor seal pool in the Forebay.[57]

In a letter to a professional colleague a few years later, Meehan described his plans for the Aquarium in more detail.[58] The main hall in the Engine House would be used for lectures; it could also be rented out for event space. An exhibit featuring freshwater fish and specimens from the New Jersey coast would be located in the Old Mill House. This would consist of approximately 85 tanks—each 7 feet wide, 5 feet high, and 5 feet deep from front to back, with a clear glass surface of 4 feet—installed in two tiers, one above the other.

In the New Mill House an exhibit of tropical saltwater fish and invertebrates was planned. There would be 27 tanks, 26 of which would be the same size as those in the Old Mill House while one would be 12½ feet long. All of the tanks would be made of reinforced concrete lined with asphalt[59] and feature glass 1¼ inches thick.

Above the Old Mill House, the hatchery would be retained in the Caretaker's House. The North and South Entrance Houses were intended to house pools for alligators, sea turtles, and other large specimens.[60]

The physical plant was to include two 80-hp boilers, two 20-ton refrigeration machines, air compressors, and pumps. Meehan expected to eventually have a staff of 25.

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[56] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (19 Dec 1911). The amount was the equivalent of approximately $358,500 in 2022.
[57] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Meehan to Kane (8 Feb 1912).
[58] Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914).
[59] The asphalt referred to here is a liquid bituminous pitch, not the common roadway pavement that uses asphalt as its binder.
[60] It is not known whether the plans for the Entrance Houses were realized.

The annual cost of operating the initial Public Aquarium, while it was still entirely housed in the Engine House, was $15,000,[61] including Meehan's salary. Meehan estimated the renovation of the Old and New Mill Houses would cost approximately $100,000.[62] When the Aquarium was finished, however, it would be nearly a third larger than the New York Aquarium, the largest at the time.[63]

Ten days after the Public Aquarium opened, Rudolph Blankenburg became mayor. True to expectations, the aquarium was not high on his list of priorities. By the middle of January 2012, the initial $1,500 had been exhausted. Six week later the Aquarium still had not received additional funds.[64] On 8 Mar Meehan reported that many of the fish had not been fed for a week. Eventually, Meehan paid for food for some of the fish out of his own pocket and caught minnows in the Schuylkill River for food for others. Worse, the staff had not been paid for three weeks. Meehan himself loaned money to one of his staff who was in particular want, but providing the entire payroll was out of the question.[65]

Even the sale of the machinery for scrap didn't help right away. After approximately three months of work,[66] contractors finished removing all of the turbines and pumps—save Turbine 1 and its associated machinery—from the Old and New Mill Houses on 21 Feb 1912. The sale brought in exactly $5,019.12.[67] Less the $1,500 advanced earlier to the mayor by the

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[61] The equivalent of approximately $458,000 in 2022.
[62] The equivalent of approximately $3.1 million in 2022.
[63] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911); Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914).
[64] Meehan to Mrs. Rudolph Blankenburg (28 Feb 1912).
[65] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (8 Mar 1912); Meehan to Sheldon Potter, Select Councilman (8 Mar 1912). This would not be the last time the Aquarium's staff would temporarily work without pay. See Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission (20 Oct 1915).
[66] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (30 Dec 1911). Meehan reported the contractors "had only begun the work of removal" when work to create an exhibition area in the Engine House began in mid-November 1911.
[67] Bureau of Water, *Chief Engineer's 1911 Annual Report* (20 Feb 1912), 36; Fred C. Dunlap, Chief of Bureau of Water, to Rudolph Blankenburg, Mayor of Philadelphia (21 Feb 1912). Dunlap's letter reported that $4,307.16 was

Bureau of Water in anticipation of the sale, the amount netted for the Aquarium was $3,519.12.[68] By the end of the first week in March, however, this amount had still not been credited to the Aquarium.[69] This was because the Aquarium's enabling ordinance of 16 Mar 1911 specified that all funds from the sale of the machinery must be deposited directly into the City Treasury and could only be paid out by special appropriation from Councils.[70]

Creating and operating the initial Aquarium on considerably less than a shoestring budget showed. One disappointed visitor wrote to Mayor Blankenburg's wife, apparently believing that was a more effective way to attract the attention of the mayor than the usual political channels. The visitor described a narrow and "long, dirty approach" to the entrance, "unsightly" displays, and "poorly executed," hand-written explanatory placards.[71] The mayor's wife discreetly passed the letter directly to Meehan instead of to her husband. While Meehan protested that the configuration of the sidewalks was under the control of the Fairmount Park Commission and out of his purview, he did acknowledge that the facility was small and "the framing of the tanks

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received from the sale of scrap iron (661.6225 tons @ $6.51 per ton) and $711.96 was received from the sale of scrap brass (8,376 lbs. @ 8½¢ per pound). The total was the approximately equivalent of $153,250 in 2022.

[68] The equivalent of approximately $107,550 in 2022.

[69] Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (8 Mar 1912). Making matters worse, the workers had to replace a skylight and other glass which had been broken in the process of removing the machinery. Some of the doors and frames in the New Mill House were also damaged but instead of replacing them in kind, Meehan had the contractors brick the openings up to the level at which a new floor was going to be constructed. In addition, one of the columns needed to be removed. It would need to be temporarily removed again when the new floor was built, so instead of immediately fitting it back in place, it was held until the construction of the floor. See Meehan to Frederick C. Dunlap, Chief of Bureau of Water (28 Feb 1912). It is not known whether the column in question was one of the cast iron columns in the New Mill House or one of the wrought iron Phoenix columns in the Old Mill House.

[70] "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 600. The language of the ordinance is clear: "The said Department [of the Mayor] is hereby authorized to sell, at the best prices obtainable, all the pumps and machinery now in the said Water Works, except one turbine wheel, one pump and such other of said machinery as is needed for the said aquarium, and *pay the proceeds thereof to the City Treasurer, who shall keep a separate account thereof, it being the intention of Councils to hereafter appropriate and devote the said proceeds to pay for the construction, installation and maintenance of the said aquarium and museum.*" [Emphasis added.] This was not a surprise; Meehan explicitly discussed it, in fact, as early as 28 Oct 1911. See Joseph Johnson, President of the Pennsylvania State Fish & Game Protective Association to William E. Meehan (26 Oct 1911); Meehan to Johnson (28 Oct 1911).

[71] Katherine Brown to Mrs. Rudolph Blankenburg (26 Feb 1912).

certainly does look cheap." He expressed his belief, however, that with the paltry level of funding that City Councils had so far provided, the City was fortunate to have any kind of public aquarium at all.[72]

Blankenburg did not want the Office of the Mayor to be directly responsible for the management of the Aquarium. By 29 Mar 1912, he had persuaded City Councils to transfer it from the Department of the Mayor to the Fairmount Park Commission.[73] A the same time Councils finally appropriated $23,700[74] for the Aquarium's operation for the year.[75] This amount included $13,250[76] for construction of a saltwater exhibit in the New Mill House and the purchase and transport of fish specimens and supplies. The remainder was set aside for staff salaries, including $3,000[77] for the director.[78] The staff would consist of an administrative assistant, ten specialists (six working during the day and four overnight), a worker to look after the pumps and other supporting equipment, and two lavatory attendants.

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[72] Meehan to Mrs. Rudolph Blankenburg (28 Feb 1912).

[73] "An Ordinance to make an appropriation to the Commissioners of Fairmount Park, for the construction and maintenance of a Public Aquarium in Fairmount Park, for the year 1912," 29 Mar 1912, *Ordinances of the City of Philadelphia and Opinions of the City Solicitor,* January 1 through December 31, 1912 (Philadelphia: Dunlap Printing Co., 1913), 27f. This ordinance is often cited as transferring the Aquarium to the Fairmount Park Commission but it does not; it merely appropriates funds to the Aquarium's operation. The transfer of responsibility must have taken place prior to the passing of this ordinance, but documentation has not been found. See also Meehan to Miss M. E. Kane, Philadelphia (8 Feb 1912); Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 9; Meehan to James D. Shea, Deputy Commissioner of the Boston Parks and Recreation Department (29 Jan 1914). In Meehan's 8 Feb 1912 letter to Kane, he states: "According to the terms of the ordinance [the enabling ordinance of 16 Mar 1911], the Aquarium was to be under the control of the Department of the Mayor, the same as other scientific and educational institutions (public schools excepted). An ordinance now pending (with the approval of the present Mayor) transfers the Aquarium from the Department of the Mayor to the Fairmount Park Commission. The ordinance comes up for final action Thursday February 15th." In Meehan's 29 Jan 1914 letter to Shea, he described the transfer from the mayor's office to the Fairmount Park Commission as occurring "a few months" after the enabling ordinance of 16 Mar 1911.

[74] The equivalent of approximately $723,600 in 2022.

[75] Presumably this amount included the $3,519.12 remaining from the sale of the machinery.

[76] The equivalent of approximately $404,600 in 2022.

[77] The equivalent of approximately $91,600 in 2022.

[78] This represented a 25 percent pay cut compared with his salary while working directly for the mayor. The superintendent's annual salary remained $3,000 until at least 1937. See "Commissioners of Fairmount Park," *Philadelphia Inquirer* (20 Dec 1927), 27; "Commissioners of Fairmount Park," *Philadelphia Inquirer* (19 Jan 1937), 33.

Construction began on the marine exhibit in the New Mill House in May 1912.[79] The building required extensive interior renovations in order to repurpose it for use as an aquarium. The turbine bays were filled and leveled with "clean fill," consisting of "cinders, clean ashes, bricks and good dirt…free of paper, tin cans, garbage, and…otherwise clean." Holes were cut in the roof deck to facilitate the loading of the fill. Before the fill could be laid, bulkheads were constructed across the openings of the three tail races in order to contain the fill. This was also done at the same time in the Old Mill House in anticipation of the need to eventually raise the floor there. O'Mara Bros., a local contractor, agreed to donate all of the materials and costs of labor.[80]

A new concrete floor would be laid over the fill. Concrete saltwater tanks and a filter bed, hundreds of feet of salt and fresh water supply pipes, separate salt and fresh water pumps, and a refrigeration plant needed to be installed. Doorways had to be cut through the old walls and new partition walls constructed. Skylights were to be built into the deck above the display tanks. A gasoline-powered engine would provide backup power.[81]

When Meehan was developing plans for the marine exhibit, today's digital age which allows for relatively easy creation, manipulation, and portability of architectural drawings was of course far in the future. The only available paper plans of the existing structures were old enough that they would fall apart if handled much; the Bureau of Water had to create special copies for Meehan's team to work with.[82]

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[79] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.

[80] Meehan to O'Mara Bros., Philadelphia (12 Feb 1912); O'Mara Bros. to Meehan (14 Feb 1912). Needless to say, the definition of "clean fill" has changed somewhat since 1912. See also "An Ordinance to make an appropriation to the Commissioners of Fairmount Park, for the construction and maintenance of a Public Aquarium in Fairmount Park, for the year 1912," 29 Mar 1912, *Ordinances of the City of Philadelphia and Opinions of the City Solicitor,* January 1 through December 31, 1912 (Philadelphia: Dunlap Printing Co., 1913), 28.

[81] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 22f.

[82] Meehan to Fred C. Dunlap, Chief of Bureau of Water (24 Feb 1912); Dunlap to Meehan (28 Feb 1912).

Meehan had originally hoped to have the saltwater exhibit finished within a few months of starting,[83] but the funding crisis and higher-than-projected costs caused delays.[84] The direct appropriation from Councils on 29 Mar 1912 was the last the Aquarium would see for years. Thereafter the Fairmount Park Commission paid all salaries, operating expenses, and costs for expansion from its own general fund.

Because of the financial constraint, as a cost savings measure Meehan used the Fairmount Park workforce to accomplish all construction in the New Mill House instead of contracting it out.[85] The lack of funds still hampered progress to such a degree, however, that construction at times came to a halt. In fact, no work at all was done during the entire year of 1913.[86] Simply keeping the buildings in a state of good repair was becoming difficult because of a lack of substantial maintenance since operational pumping had ceased.[87]

Expansion was happening somewhere in 1913, just not at the Aquarium. Site preparation for the planned art museum atop Fairmount began in the late summer[88] and was completed by the end of the following summer.[89] The work included demolition of the Fairmount Reservoir, removal of the reservoir's retaining walls, and partial excavation of the summit to create a plaza 600 feet wide and 400 feet deep, upon which the art museum would be constructed. The southeast corner of Fairmount was deeply excavated in order to create a frontage for the museum facing Center City along the axis of the Fairmount Parkway being constructed at the time. Much

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[83] Meehan to Kane (8 Feb 1912).
[84] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 22f.
[85] Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914).
[86] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914), 12.
[87] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 12. Proper upkeep of the buildings, which would be a problem throughout the Aquarium's existence, was a challenge from the very beginning.
[88] Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914), 7f); "City Awaits Art Gallery Decision," *Philadelphia Inquirer* (28 Sep 1913), 11.
[89] Fairmount Park Commission, *1914 Annual Report* (13 Jan 1915), 9f.

of the demolition and excavation rubble was retained in the area of the North Garden, destroying it. Eventually the material would be used to dramatically re-grade this area, completely obliterating the North Garden in the process.

Before the work of re-shaping the crest of Fairmount was begun, in March 1913 all of the water was drawn off from all but one of the basins in Fairmount Reservoir. Approximately 15,000 fish, mostly yellow perch and sunfish, were recovered; a small number was kept for the Aquarium and the rest were released into the Wissahickon Creek and in lakes and ponds throughout Fairmount Park.[90]

The remaining turbine continued to pump water from the Schuylkill River up to the remaining basin for use by the Aquarium until September 1913 when it broke down. Since the entire Fairmount Reservoir was within months of being razed as part of the art museum's site preparation anyway, this was of little concern. The Aquarium switched from river water to municipal water—city tap water—for its supply. Because the Schuylkill River suffered from high levels of pollution at this time, the result was a noticeable improvement in both the appearance of the exhibit tanks and the health of the fish within them.[91]

In the fall of 1913 a small greenhouse was constructed on the deck of the Old Mill House in the space between the Engine House and the Caretaker's House for "still water Aquarium fishes requiring warm water temperature." The greenhouse accommodated fancy goldfish and seventeen species of tropical freshwater fish.[92]

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[90] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); "City Awaits Art Gallery Decision," *Philadelphia Inquirer* (28 Sep 1913), 11.

[91] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914),. The chlorine in the municipal water would in time have an adverse effect on the health of the fish.

[92] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914).

Although not enough funds were provided to advance work on the marine exhibit in the New Mill House during 1913, enough was scraped together to repair the "dilapidated" superstructures on the deck of the Old Mill House—the Caretaker's House, South Entrance House, Pavilion, North Entrance House, and Watering Committee Building. The cast iron balustrade and cast iron fences along the Cliffside Paths were repaired, and the Standpipe was repaired and repainted at this time as well.[93]

Sometime in 1912 or 1913, the Aquarium's name was changed from the "Public Aquarium and Museum" to the "Fairmount Park Aquarium."[94] During the same period, perhaps on his own initiative, Meehan also dropped the title of Director and adopted the title of Superintendent.[95]

In July 1913, while the Aquarium was still operating out of only the Engine House, Meehan acquired twelve harbor seals from Boothbay Harbor, Maine.[96] In preparation, the Forebay had been given a thorough cleaning the previous year.[97] Seals don't mind the cold, so they were kept year-round in the inner Forebay after it was given a thorough cleaning.[98] Meehan described the Forebay as "undoubtedly the largest seal pool in the country, and admirably

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[93] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914).

[94] The latest use of the name "Public Aquarium" discovered by this editor is in Meehan to Rudolph Blankenburg, Mayor of the City of Philadelphia (8 Mar 1912) and Meehan to Sheldon Potter, Select Councilman (8 Mar 1911). The earliest use of the name "Fairmount Park Aquarium" discovered by this editor is in Meehan to Witmer Stone, Academy of Natural Sciences (27 Sep 1913). See also William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance*, souvenir booklet (Fairmount Park Commission, 1929), 4.

[95] Sheldon Potter, Select Councilman, to Meehan (8 Mar 1912); Meehan to Witmer Stone, Academy of Natural Sciences (27 Sep 1913); Meehan to James D. Shea, Deputy Commissioner, Parks and Recreation Department of the City of Boston (29 Jan 1914). In his correspondence of 29 Jan 1914, Meehan explained the reason for the change in title: "A City Ordinance makes the title of my position, Director; but all heads of Bureaus under the Fairmount Park Commission are entitled to Superintendants [*sic*] by the Park Commission. When the Ordinance was first created by ordinance of Councils, it was placed directly under the Mayor, but a few months later was transferred to the Park Commission."

[96] Meehan to Witmer Stone, Academy of Natural Sciences, 27 Sep 1913; Fairmount Park Commission, *1913 Annual Report* (15 Jan 1914), 12.

[97] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 22f.

[98] Fairmount Park Commission, *1912 Annual Report* (8 Jan 1913), 22f.

adapted for the needs of this class of water carnivora."[99] During the winter, Aquarium staff would break holes in the ice so the seals could frolic in the water; the animals would often eat and sleep on the solid surface.[100] Popular among visitors, the seals attracted crowds, especially at feeding time.[101]

The Forebay was perhaps not as "admirably adapted" for seals as Meehan claimed, however. The grate which had been placed over the three archways under the Forebay Bridge was not as secure as it should have been and eight of the seals escaped within a few days of their arrival. One of the escapees was soon recaptured unharmed by Aquarium staff members: six were never found.[102]

The last missing seal to be recovered was found a week after its escape, in the Maurice River in Leesburg, New Jersey, approximately 85 miles away from Fairmount by water. Unfortunately a local resident had wounded it with a shotgun. It was returned to the Aquarium where it appeared to be recovering, but it bolted again and was found dead on the rocks just below the Fairmount Dam which become exposed when the tide is out. Meehan offered the animal's carcass to the Academy of Natural Sciences in Philadelphia for study.

The five seals in captivity[103] subsequently broke the grate over the Forebay's waste gate; three of them quickly escaped, never to be recovered. One of the two remaining seals developed

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[99] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914).
[100] See for example, Meehan to Raymond C. Osbourn, New York Municipal Aquarium (24 Jun 1914); Day Attendants' Report, Fairmount Park Aquarium (23 Dec 1915); Assistant Superintendent's Day Report, Fairmount Park Aquarium (6 Dec 1917).
[101] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); *Assistant Superintendent's Day Report,* Fairmount Park Aquarium (6 Dec 1917).
[102] "One Errant Seal Back in Aquarium," *Philadelphia Inquirer* (23 Jul 1913), 3.
[103] The four that never left plus the one that was recaptured.

tuberculosis and died the following February.[104] For those keeping score at home, that means that of the twelve seals purchased in the summer of 2013, only one remained through the end of the winter. Despite being named "Kaiser,"[105] the remaining seal was a female and gave birth to two pups early the next summer.[106]

Keeping the seals fed was a challenge. Each seal consumed ten pounds of fish per day, procured from local wholesalers. Meehan found he had to increase refrigeration capacity in order to prevent the large quantities of dead fish on hand from spoiling before they were eaten.[107]

The seals were such a draw, however, that despite the difficulties in providing for their support, Meehan scoured potential sources for replacements.[108] The year after the first twelve were purchased (and eleven lost), Meehan acquired twelve more from the same supplier.[109] In 1915 he purchased a sea lion from a supplier in San Francisco.[110] When he couldn't purchase seals from a supplier outright, Meehan managed to rent them during the winters from the famous

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[104] Meehan to Witmer Stone, Academy of Natural Sciences (27 Sep 1913); Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1913 Annual Report* (c.Jan 1914); Meehan to Janet Macdonald (23 Apr 1914); Meehan to Raymond C. Osbourn, Municipal Aquarium, Battery Park, New York (24 Jun 1914). In 1919 a seal in the Delaware River was shot and killed by a hunter who lived in South Philadelphia. Unconfirmed speculation at the time was that this was one of the seals that had escaped six years earlier. See photograph and caption, *Evening Public Ledger* (31 Oct 1919), 36.

[105] "12 Arctic Seals Reach Aquarium," *Philadelphia Inquirer* (15 Jul 1914), 5.

[106] "Bring 12 Seals Here to Swim in Park Aquarium," *Philadelphia Inquirer* (12 Jul 1914), 17.

[107] Meehan to Walter Q. Thomas, Belmont Office of Fairmount Park Commission (9 May 1914).

[108] See Aquarium correspondence of 17 Apr 1915, 23 Apr 1915, 24 Apr 1915, 25 Apr 1915, 26 Apr 1915, 27 Apr 1915, 29 Apr 1915, 30 Apr 1915, 1 May 1915, 3 May 1915, 5 May 1915, I Jun 1915, 27 Jun 1915, 1 Jul 1915, 10 Sep 1915, 11 Sep 1915, 23 Sep 1915. Meehan's inquiries were extended as far afield as Santa Barbary and San Francisco, California.

[109] Meehan to Janet Macdonald (23 Apr 1914); "Bring 12 Seals Here to Swim in Park Aquarium," *Philadelphia Inquirer* (12 Jul 1914), 17; "12 Arctic Seals Reach Aquarium," *Philadelphia Inquirer* (15 Jul 1914), 5. Three of these seals were "lost" to unknown causes. See Meehan to Janet McDonald, Bayville, Maine (30 Apr 1915).

[110] Meehan to H. W. Winston (1 Jun 1915); Winston to Meehan (27 Jun 1915). A year after the sea lion was purchased, it escaped. After swimming part way down the Schuylkill River, it somehow became stuck between pilings which surrounded one of the piers of the Gray's Ferry Bridge. It was recovered and returned to the Aquarium with the help of staff members from the Pennsylvania Society for the Prevention of Cruelty to Animals and Philadelphia police officers aboard the police tug *Reyburn*. See "Sea-Lion Found Wedged in Pillar of River Bridge," *Philadelphia Inquirer* (30 Jul 19261), 1.

Million Dollar Pier[111] in Atlantic City, New Jersey. Three seals and three sea lions were temporarily obtained from the Jersey shore attraction in this way in November 1914.[112] Unfortunately one of each died during their winter stay at the Aquarium and had to be replaced.[113] Two additional seals and two sea lions were rented from the same source in September 1915.[114] One of the seals on hand died in October 1915.[115]

The following year one of the sea lions escaped but managed to get itself stuck between two support pillars of the Gray's Ferry Bridge over the Schuylkill River, approximately three miles downstream of Fairmount. Working from a police tug, police officers and staff from the Pennsylvania Society for the Prevention of Cruelty to Animals freed the animal and returned it to the Aquarium.[116]

In August 1917 an additional seven sea lions were obtained.[117] It was discovered shortly after their arrival, however, that some of the animals had tuberculosis. The disease spread through the herd and by the end of the year three had died and two more were sick.[118]

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[111] Showman John L. Young built the Million Dollar Pier in 1906 and operated it until his death at age 84 in 1938. Shortly afterward, George Hamid purchased the attraction and operated it until 1948. See "John L. Young, 84, of Atlantic City," New York Times (16 Feb 1938, 21; "Atlantic City Greets Summer Cottagers," *Pittsburgh Sun-Telegraph,* (12 Jun 1949), 59.

[112] Meehan to Million Dollar Pier, Atlantic City, New Jersey (12 Nov 1914).

[113] Meehan to W. E. Shackleford, Manager of Million Dollar Pier (17 Apr 1915); W. E. Shackleford to Meehan (23 Apr 1915); Meehan to W. E. Shackleford (24 Apr 1915). Meehan offered to purchase the animals outright instead of renting them but Shackleford declined the offer, citing his need to keep the popular animals during the summer tourist seasons. See also Aquarium correspondence of 10 Sep 1915, 11 Sep 1915, and 23 Sep 1915. While the well-known John L. Young was the owner and operator of the attraction, Shackleford was the manager during this period.

[114] W. E. Shackleford to Meehan (10 Sep 1915); Meehan to Shackleford (11 Sep 1915); Meehan to Shackleford (23 Sep 1915).

[115] "Night Attendants' Report, Second Shift," *Fairmount Park Aquarium* (12 Oct 1915). Attendant's entry: "Seal appears to be dead in the forebay." If the attendant was not meticulous about differentiating between seals and sea lions, this may have been the large bull sea lion which in April 2015 was reported to have "taken violently ill" and subsequently suffered from inflamed flippers. The animal was "dosed…with castor oil" at the time. See Meehan to W. E. Shackleford, Million Dollar Pier, Atlantic City, New Jersey (3 May 1915). A bull seal was apparently named "King." See "'Society Fish' to Arrive," *Evening Public Ledger* (6 Oct 1915), 5.

[116] "Sea-Lion Found Wedged in Pillar of River Bridge," *Philadelphia Inquirer* (30 Jul 1916), 1.

[117] *Fairmount Park Commission 1917 Annual Report* (9 Jan 1918), 9.

[118] *Fairmount Park Commission 1917 Annual Report* (9 Jan 1918), 9; Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission (26 Oct 1918).

In 1914 the Aquarium's staff consisted of the superintendent, with an annual salary of $3,000;[119] an administrative assistant at $1,000;[120] a foreman/pumpman at $900;[121] seven attendants (two of which worked the night shift), at $800 each;[122] a male attendant for the men's room, at $600;[123] and a female attendant for the ladies' room, also at $600.[124] Meehan thought his staff members were underpaid and reported that their salaries were less than those of comparable staff in the municipal aquariums in New York and Boston.[125]

A heating plant was constructed within the northeastern corner of the Old Mill House and steam radiators were installed throughout the entire facility in the summer of 1914.[126] Despite Meehan's admonishment to the contractor's workers to be careful, as the two new 80-hp boilers were being transported across the Forebay Bridge nearly half of the parapet balustrade on the north side of the Bridge and two thirds of the balustrade on the south side was smashed and knocked into the Forebay. George B. Clopp, who owned a company that specialized in structural and ornamental metals, was engaged to repair the damage at the contractor's expense.[127]

The same year, the decks of both Mill Houses were given an additional coat of asphalt.[128] Electric lighting was installed in the Engine House[129] (and thereafter in the marine exhibit in the

[119] The equivalent of approximately $88,850 in 2022.
[120] The equivalent of approximately $29,617 in 2022.
[121] The equivalent of approximately $26,655 in 2022.
[122] The equivalent of approximately $23,694 in 2022. Apparently there was no shift differential.
[123] The equivalent of approximately $17,770 in 2022.
[124] Meehan to James D. Shea, Deputy Commissioner of Parks and Recreation Department of the City of Boston (29 Jan 1914). No gender pay gap here.
[125] Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914).
[126] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1914 Annual Report* (12 Jan 1915); *Fairmount Park Commission 1914 Annual Report* (13 Jan 1915), 13.
[127] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission (30 Jun 1914). Clopp was also the manufacturer of the metal facades for the display tanks. See George B. Clopp, Structural and Ornamental Iron Works, to Meehan (7 Jan 1914).
[128] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission, *Fairmount Park Aquarium Superintendent's 1914 Annual Report* (12 Jan 1915).
[129] Fairmount Park Commission, *1914 Annual Report* (13 Jan 1915), 13. Recall that the Aquarium's enabling ordinance in 1911 directed the City's Electrical Bureau to install electrical lighting and supply electricity at the City's expense.

New Mill House and freshwater exhibit in the Old Mill House as those exhibit areas were completed). Lamp posts with tungsten lights were erected around the grounds in 1915.[130]

Around this time, managers of large aquariums began to experiment with the use of ozone. Meehan considered introducing the gas in the water of the display tanks but eventually decided that the potential benefit—helping to keep the water clean and clear—was not worth the expense of the necessary machinery and the labor-intensive monitoring that would be necessary.[131]

Two suggestions for the development of the grounds around the Aquarium were floated beginning in 1914. One of the commissioners of Fairmount Park, Theodore Justice, had been a recent appointee. Already having a detailed knowledge of the park because of living near the western portion, he took to his duties with gusto. He took a nine-month trip across Europe, touring numerous parks and making extensive notes of what he found. He believed Fairmount Park to be "behind the times" and in need of development to better serve the needs of the people of Philadelphia.

Commissioner Justice proposed an artificial waterfall be constructed along the cliff face of Fairmount immediately above the Forebay. Superintendent Meehan had suggested this in a letter to Fairmount Park Commission Chief Engineer Vogdes in April 1914 and Justice picked up the idea, comparing it to man-made waterfalls he had seen in parks in Europe such as St.

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[130] Fairmount Park Commission, *1915 Annual Report* (12 Jan 1916), 8.

[131] Meehan to Tarleton H. Bean, New York State Conservation Commission (25 Feb 1915 and 27 Feb 1915). Ozone (O_3) is a molecular form of oxygen which consists of three atoms of oxygen, versus two atoms (O_2) for the form of oxygen which humans and animals breathe. Its use in the Aquarium at this time was not a farfetched idea. Ozone is used in many large aquariums even today. It helps to clarify and disinfect the water and discourage the growth of algae. But Meehan was right. The use of ozone requires specialized equipment, fittings, and connections to prevent corrosion and deterioration. It needs close monitoring to ensure the level is kept within tight parameters; too much can harm the health of the fish as well as humans visiting and working at the facility. At the time, the use of ozone would undoubtedly have caused more problems than it solved. See also "Diving into the World of Ozone," *reefs.com* (2020), <https://reffs.com/2017/12/19/diving-world-ozone>, accessed 7 Jan 2021.

Stephen's Green Park in Dublin, Victoria Park in Berlin, and Villa d'Este in Tivoli.

Meehan and Justice believed a waterfall was just the thing to beautify the Aquarium's grounds. The cascade would be located in the cleft or small gorge where the ascending mains had run up to the Fairmount Reservoir and would run between four and six feet wide. One of the basins of the Fairmount Reservoir would be retained and the remaining turbine would be used to pump water up to it. From the basin, water would fall through and under the arched stone structure beside the Standpipe and down the face of the cliff, splashing around artfully arranged boulders and into the Forebay. Meehan even thought a fountain could be placed on the remaining stone abutment at the base of the cliff which had supported the ascending mains at the eastern end of the Forebay.

With a capacity of approximately 2½ million gallons per day, the turbine could easily handle the load. A concrete tank would need to be constructed behind the arched structure atop Fairmount in order to receive water from the remaining basin (or directly from the turbine) and regulate the flow. Justice estimated all of the necessary work could be accomplished for $3,000.[132] If additional power were needed during dry periods, an electrically powered centrifugal pump could be installed for an additional $10,000.[133]

A design was prepared by J. Frank Copeland of the School of Industrial Design and formally submitted to the Fairmount Park Commission in January 1915. The plan got as far as a resolution to refer the idea to the Committee on Plans and Improvements for a determination on its feasibility, but it was never implemented.[134]

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[132] The equivalent of approximately $88,900 in 2022.
[133] The equivalent of approximately $296,200 in 2022.
[134] Meehan to Vogdes (16 Apr 1914); "Cascade Planned Near Art Museum," *Evening Bulletin* (14 Jan 1915); "Board Studies Design for Park Waterfall," *Evening Bulletin* (14 Jan 1915); "Wants Waterfall in Fairmount Park," *Philadelphia Press* (14 Jan 1915); "Proposes Waterfall for Fairmount Park/Wants Prehistoric Zoo," *Evening Bulletin* (17 Jan 1915).

The second suggestion was a little more unusual. Commissioner Justice proposed the construction of a park containing life-size concrete recreations of prehistoric animals.[135] Located at the base of Fairmount in the vicinity of the South and North Gardens, as well as on the slopes of Fairmount, it would be modeled after similar park features Justice had seen in Germany during his travels, especially Tierpark, created by Carl Hagenbeck, a world-famous animal trainer and zoo exhibitor.[136] Natural settings would be created, including a swamp-like pond in one of the level areas.[137]

The colorful concrete facsimiles would be up to 80 feet long and 20 feet tall and include Tyrannosaurs, Brontosaurus, Triceratops, Diplodocus, Stegosaurus, and Iguanodon. Most of the figures would cost between three and five thousand dollars each,[138] but a few of the smaller species would cost under three hundred dollars each.

With the encouragement of officials at the Academy of Natural Sciences for the dinosaur park, Commissioner Justice proposed a pedestrian bridge across the Schuylkill River in front of the Fairmount Dam as a way of connecting the area of Fairmount Park where the Philadelphia Zoo was located with the area of the Fairmount Water Works, the Fairmount Aquarium, and the dinosaur exhibit area. Bureau of Surveys Chief Webster prepared plans for the bridge and the

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[135] "Prehistoric Garden for Park Now Urged/Footbridge Over Dam," *Evening Bulletin* (19 Jan 1914); "Prehistoric Zoo Planned in Park," *Evening Bulletin* (8 Apr 1914); "Justice Proposes Mute Zoo As New Park Attraction," *Evening Bulletin* (20 Sep 1914); "Proposes Waterfall for Fairmount Park: Wants Prehistoric Zoo," *Evening Bulletin* (17 Jan 1915).

[136] Tierpark (lit. "animal park" or "zoo") was located in Stellingen, near Hamburg, Germany. Hagenbeck pioneered the exhibition of animals in natural settings, with spacious, moated enclosures instead of claustrophobic cages with bars. His exhibitions included concrete prehistoric animals in lifelike settings. See "How Hagenbeck Became the Wild Animal King," *New York Times* (20 Apr 1913), 9ff; Eric Ames, *Carl Hagenbeck's Empire of Entertainments* (University of Washington Press, 2009).

[137] A similar exhibit area, the famous Dinosaur Court, still exists in Crystal Palace Park in South London. Created in 1854 by Benjamin Waterhouse Hawkins, it is a Grade I listed (historically protected) display of 30 dinosaurs as they were envisaged during the mid-nineteenth century. See *Friends of Crystal Palace Dinosaurs* (2013–2022), <https://cpdinosaurs.org/>, accessed 8 Oct 2022; *Crystal Palace Park* (2022), <www.crystalpalaceparktrust.org>, accessed 8 Oct 2022; "Crystal Palace Park," *Bromley: The London Borough* (2022), <www.bromley.gov.uk/crystalpalacepark>, accessed 8 Oct 2022.

[138] The equivalent of approximately $88,800–148,100 in 2022.

Fairmount Park Commission requested $30,000[139] for its construction from City Councils.

Nothing came of any of these three ideas, most likely because of the costs involved. In the case of the prehistoric park, Hagenbeck died in 1913 and although family members continued his work, the difficulty of working with people from Germany during World War I cannot be exaggerated. In fact, Fairmount Park Commission Chief Engineer Jesse T. Vogdes also visited Tierpark during the summer of 1914, but had to destroy his notes lest he be mistaken for a spy.

Another factor to consider is the way in which Commissioner Justice, as a newcomer, was received by his fellow commissioners. As one newspaper article put it at the time,

> Some of the old-timers on the board who enjoy the prestige and political patronage which belongs to membership of that body have difficulty in suppressing their annoyance at the public spirit and genuine interest in the park shown by Justice. … These and other activities in the interest of the park are sometimes provoking to other members of the commission.[140]

"Mr. Justice goes right ahead," the writer nevertheless concluded, "and gradually the pullbacks are forced to give their support to his projects."[141] Apparently this was not always the case.

When construction on the marine exhibit in the New Mill House was begun in May 1912, Meehan expected it would be finished within a few months. Funding issues and unexpected problems caused delays far beyond Meehan's projections. In surviving correspondence, he indicates numerous times from 1913 through 1915 that completion was imminent. In 1915 Meehan resorted to paying for the acquisition of fish from his own personal finances. Even at that, he had to ask the supplier to keep the fish in storage because the exhibit was not ready to

[139] The equivalent of approximately $888,500 in 2022.
[140] "Proposes Waterfall for Fairmount Park/Wants Prehistoric Zoo," *Evening Bulletin* (17 Jan 1915).
[141] "Proposes Waterfall for Fairmount Park/Wants Prehistoric Zoo," *Evening Bulletin* (17 Jan 1915).

receive them.[142] In addition to the funding-related work stoppage during the entire year of 1913, unexpected issues like the inability of plate glass suppliers to promptly produce and deliver the necessary 1¼-inch thick glass and the timing of the availability of marine fish kept pushing back the new facility's opening. As the work became increasingly protracted, Meehan's frustration grew. In correspondence Meehan openly described the delays as "aggravating" and "exasperating."[143]

By August of 1915 the saltwater exhibit was finally far enough along that Meehan took delivery of 100,000 gallons of sea water. Two deliveries were made of 50,000 gallons each, taken off the coast of New Jersey near Cape May. The water was pumped onto barges which were towed up the Delaware River, then up the Schuylkill River to the Aquarium at Fairmount.[144] The Director of Public Safety provided a steam-powered fire engine to pump the water approximately twenty feet up to the bridge from the first ship, but the engine couldn't generate enough power to bring the water all of the way up. Meehan ultimately did manage to secure the delivery of the sea water, likely with the assistance of a tug boat pump.[145]

Before the marine exhibit was completed, work got under way in 1915 to convert the Old Mill House into a freshwater exhibit. Although the work slowed to a halt before long, due to supply problems caused by America's support of the Allies during the initial stages of World

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[142] Meehan to C. H. Townsend, Director of New York City Municipal Aquarium (24 Sep 1915).

[143] Meehan correspondence: to Miss M. E. Kane, Philadelphia (8 Feb 1912); to R. J. Conway, Director of Aquarium, Michigan Department of Parks and Boulevards (30 Dec 1913); to James D. Shea, Deputy Commissioner of Parks and Recreation Department, City of Boston (29 Jan 1914); to Vogdes, Chief Engineer of Fairmount Park Commission (c.Jan 1914); to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914); to Vogdes, Chief Engineer of Fairmount Park Commission (12 Jan 1915); to Hugh M. Smith, Fish Commissioner, U.S. Bureau of Fisheries (26 Apr 1915); to C. H. Townsend, New York City Aquarium (9 Jul 1915); to R. J. Conway, Director of Aquarium, Michigan Department of Parks and Boulevards (22 Jul 1915); to Phillip H. Hartman, Superintendent of Erie Hatchery (26 Jul 1915); to David G. Stead, Commissioner of State Fisheries, New South Wales, Australia (9 Aug 1915).

[144] "News of the Ships and Shipping Men," *Philadelphia Inquirer* (30 Apr 1926), 20.

[145] Meehan to Captain Tracy, Philadelphia (17 Jun 1915); Meehan to Walter Q. Thomas, Belmont Office, Fairmount Park Commission (8 Jul 1915); Meehan to George D. Porter, Philadelphia Director of Public Safety (9 Aug 1915); Meehan to Walter Q. Thomas, Belmont Office, Fairmount Park Commission (27 Aug 1915).

War I,[146] the Fairmount Park Commission did install electric “tungsten lights” throughout the surrounding grounds.[147]

The marine exhibit managed to open in the New Mill House on 15 Jun 1916,[148] essentially as Meehan had earlier described.[149] There were 25 display tanks arranged on the two long sides of the rectangular interior and eight all-glass “table tanks” in the middle of the room. Although the emphasis was on marine specimens, one entire length of side tanks displayed freshwater fish.[150]

One of the side tanks had capacity of 3,000 gallons and a glass viewing surface twelve feet wide and six feet high. The other 24 had capacities of 1,300 gallons each and were seven feet wide and five feet high. The table tanks averaged around five by two and a half feet and together contained 150 gallons.[151] Meehan was particularly proud of several 50-pound drum fish, a 35-foot Green Moray Eel, and a number of red hind fish which change colors when excited. Over a thousand people visited on opening day.[152]

Meehan considered the tanks from the St. Louis exhibition, used in the Aquarium’s display space in the Engine House, to be “old fashioned”[153] and “antiquated,”[154] but most of the tanks in the marine exhibit in the New Mill House were newly built. In many of the tanks

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[146] Fairmount Park Commission, *1915 Annual Report* (12 Jan 1916), 7; *Fairmount Park Aquarium* (1929), 4.
[147] Fairmount Park Commission, *1915 Annual Report* (12 Jan 1916), 8.
[148] Fairmount Park Commission, *1916 Annual Report* (10 Jan 1917), 5; William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.
[149] The exhibit area was completed four years and a month after work began, far longer than the few months Meehan had originally anticipated. See Meehan to Kane (8 Feb 1912).
[150] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.
[151] Fairmount Park Commission, *1916 Annual Report* (10 Jan 1917), 5.
[152] “New Quarters of Park Aquarium are Opened,” *Philadelphia Inquirer*(16 Jun 1916), 10.
[153] Meehan to Superintendent of Aquarium, Brighton, England (11 Jan 1915).
[154] Meehan to Jesse T. Vogdes, Chief Engineer of Fairmount Park Commission (12 Jan 1915).

coquina rock was used to simulate a natural environment.[155] The rows of tanks featured façades composed of Monel®,[156] a corrosion-resistant nickel-copper alloy metal. Most of the exhibits were of marine fish, but one row of tanks did feature freshwater species.[157] Out of public view there were eleven work tanks of concrete lined with asphalt.

With the marine exhibit added to the initial exhibit in the Engine House, attendance for the following year rose to 372,584.[158] Loggerhead turtles in the marine exhibit were a favorite of children. One average-sized turtle was caught by a local sportsman in the Chesapeake Bay in 1920 and donated for the marine exhibit. Named Bill by Aquarium staff, it died three years later.[159] Another specimen was rather more impressive. When it died sometime after, it was preserved and suspended above an arched passageway between the Old Mill House and New Mill House.[160]

Public safety and the security of the Aquarium grounds was always a concern. Children found ways to circumvent the fencing around dangerous areas and clambered up and down the steep slopes. This was a particular problem on weekends, when school was out. In one month during the summer of 1919 alone, four children fell from high places; three suffered broken bones. Others were found throwing rocks down on people and breakable objects. Two electric

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[155] Meehan to Secretary of Florida Board of Trade (7 Apr 1914); J. W. Stanford, Jr., Saylor's Portland Cement, to Meehan (22 Apr 1914); S. H. Gove, Architect, to Meehan (15 May 1914). Coquina (from Spanish for "cockle shell") is a relatively light sedimentary rock composed of marine shell fragments.

[156] George B. Clopp, Structural and Ornamental Iron Works, to Meehan (7 Jan 1914). Monel® is a nickel-copper alloy, not a steel alloy. Today a registered trademark of Special Metals Corporation, it was patented by Ambrose Monell of the International Nickel Company in 1906. See Ambrose Monell, *Manufacture of Nickel-Copper Alloys, Patent 811,239* (U.S. Patent Office, 30 Jan 1906); "Monel," *Encyclopædia Britanninca* (2021), <www.britannica.com/technology/monel>, accessed 5 Jan 2021; "Product focus—MONEL alloy 400," *Corrotherm International* (2021), <www.corrotherm.co.uk/blog/product-focus-monel-alloy400>, accessed 5 Jan 2021); "Nickel & Cobalt Alloys," *Special Metals Corporation* (2021), <www.specialmetals.com/products>, accessed 5 Jan 2021.

[157] Fairmount Park Commission, *1916 Annual Report* (10 Jan 1917), 5f; *Fairmount Park Aquarium* (1929), 4.

[158] Fairmount Park Commission, *1917 Annual Report* (9 Jan 1918), 10.

[159] "Frisky 'Bill' Dead," *Evening Bulletin* (30 Jul 1923). The account states that this particular turtle was buried after it died.

[160] *Aquarium,* photograph, 8 in. × 10 in. (9 Jul 1930), Image 28924. Accession 2004.101.0042, collection of Philadelphia Water Department Historical Archives.

light fixtures were destroyed. Meehan requested a dedicated guard be deployed at the top of the Cliffside Paths during daylight hours.[161]

On 28 Jul 1919, construction began on the art museum atop the regraded Fairmount.[162] The initial funding wasn't sufficient to finish construction so the outer wings were started first, with the idea that it would be more difficult to put off funding the completion of the central core of the building once the outer wings were up than it would be to delay the wings and only leave the core.[163]

During the final week of December 1920 the Distribution Arch and Standpipe were demolished, despite pleas for their preservation and specific language in the Aquarium's enabling ordinance of 1911 describing City Councils' intention of preserving the structures.[164] Fairmount Park Commission officials at the time probably decided that the Italianate architectural style of the two structures didn't fit with the neoclassical setting they were attempting to create in the area of the art museum. That the structures thrust themselves so prominently into view—ruining the careful symmetry of the new landscape behind the art museum—just made it worse. Their uncompromising incongruity meant they had to go.[165] "Heavy charges of dynamite," a local newspaper reported, sent pieces "high in the air" and the

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[161] Meehan to Alan Carlson, Chief Engineer of Fairmount Park Commission (4 Jul 1919).

[162] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 64. Sources cited in Brownlee: *Fairmount Park Commission Minutes*, Vol. 14 (28 Jun 1919), 78; (24 Jul 1919), 92f; (8 Oct 1919), 95f; *Philadelphia City Archives*, 149.1; "Eleven Proposals for Museum," *Public Ledger* (5 Jun 1919), 13; "Injunction Denied on Parkway Job," *Public Ledger* (22 Jul 1919), 5.

[163] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 67.

[164] "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 598ff. The mayor signed the ordinance on 16 Mar. See (prob.) *Journal of the Select Council of the City of Philadelphia*, from the same period, 44ff (in author-editor's possession). From the ordinance: "It is desirable that the beautiful buildings, together with the standpipe or water tower, be preserved for all time as a fine example of the earlier architecture and methods of supplying water to the people of Philadelphia."

[165] This author-editor could find no documentary evidence for the origin or timing of the decisions to demolish the Standpipe and Distribution Arch and fill in the Forebay.

famous landmarks "fell in a crashing, dust-covered pile."[166] It seems that the time capsule within the cornerstone of the Distribution Arch was not recovered.[167]

The debris from the demolition was added to the rubble that had earlier been set aside in the area of the North Garden in 1913 and 1914 during site preparation for the art museum, as well as the new excavation rubble produced by the construction of the foundations and lower levels of the art museum itself. It was around this time that some of this material was used to fill in the Forebay. With no other facility with which to house the seals and sea lions, those popular exhibits were consequently discontinued.[168]

The freshwater exhibit, delayed by America's support for the Allies and then active participation in World War I, opened in the Old Mill House on 24 Nov 1921, Thanksgiving Day.[169] Two rows of display tanks were arranged, one on either side of the long interior hall. A free-standing tank in the middle of the hall contained an electric eel. Additional tanks were arranged in the wedge-shaped area between the Old Mill House and New Mill House. Additional

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[166] *Evening Bulletin* (4 Jan 1921). The newspaper account reports the structures were demolished "during the past week." Since the article was published on a Tuesday, the phrase should probably be interpreted as meaning the previous full week, viz. the last week of December 1920.

[167] "Corner Stone Laid," undated clipping from unknown newspaper, Newspaper Clipping Scrapbook of Frederic Graff, Jr., 140. Philadelphia Water Department Historical Archives, Accession 2004.071.001. The 1861 time capsule contained a message from the mayor, the Chief Engineer's most recent annual report, copies of local newspapers, and the names of 54 Water Department employees who were then fighting for the Union in the Civil War. Unfortunately, this author-editor could find no record of the time capsule having been recovered during demolition of the Distribution Arch.

[168] Photographic evidence suggests that at least a portion of the outer Forebay was filled with excavation rubble from atop Fairmount. See *Fairmount Water Works: Filled In Reservoir, Before Demolition of Standpipe and Distribution Arch and Prior to Construction of Art Museum on the Site,* photograph (29 Jul 1920), Image 5776, Fairmount Park Historic Resource Archives, Accession 2004.090.0062, Philadelphia Water Department Historical Archive. In addition, a plan of the area from the Department of Public Works in 1928 indicates that some portions of the outer Forebay were filled with a mixture of "loose stone and sand" over a layer of boulders and some with a mixture of only "sand and clay." The boulders and loose stone are likely excavation rubble from Fairmount. See *Main Relief Sewer Through Fairmount Park,* blueprint (Department of Public Works, 1928). When the inner Forebay was partially excavated in the mid-1980s, the fill there was found to be mostly clay, not demolition rubble. C. Drew Brown, Public Education Manager, Philadelphia Water Department, telephone interview with author-editor, 4 Apr 2021.

[169] "4000 at Opening of City Aquarium," *Evening Bulletin* (25 Nov 1921); William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.

working tanks and other infrastructure for supporting activities were installed behind the exhibit tanks, out of public view.[170] Meehan had intended to install a large window in the Forebay wall of the Old Mill House so visitors could watch the seals and sea lions as they swam underwater. Work on the necessary opening had even begun in June 1919, but the idea had been abandoned and the work halted when it was decided to fill in the Forebay.[171] Instead of live seals and sea lions, one of the seals that had died from tuberculosis was stuffed and displayed in a glass case in the middle of the central hall.[172]

Ten years to the day from its initial opening in the Engine House, the Aquarium was completed, essentially as Meehan had originally envisioned it. For the first time in twelve years, the sounds of visitors could be heard in all three buildings of the Fairmount Water Works once again. Where breast wheels, turbines, and pumps once labored, there were now crowds of visitors—adults, children, school groups on field trips, families on outings, and couples on dates.

Many freshwater specimens continued to be provided by Pennsylvania state hatcheries. The majority, however, were collected by Aquarium staff from rivers, streams, lakes, and ponds in Pennsylvania and New Jersey, mostly using various types of nets. The fish were then brought in on trucks, each carrying one or two large, 800-gallon wood crates lined with waterproof canvas, or a few 200-gallon oval can. Both crates and cans would be filled to only half their capacity to facilitate the aeration supplied continuously during transport. At times, fish were shipped in the baggage car of a train, accompanied by an attendant with an air pump.[173]

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170 Although hidden behind the façades of the display tanks, all 24 of the Phoenix columns, installed from 1867 to 1870, were left in place.
171 Meehan to Allan Corson, Chief Engineer of Fairmount Park Commission (4 Jul 1919).
172 "4000 at Opening of City Aquarium," *Evening Bulletin* (25 Nov 1921).
173 William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 6, 7.

In 1922, Assistant Superintendent Robert O. Van Deusen[174] mounted the first[175] of what was to become many annual expeditions to Key West, Florida, to obtain tropical marine fish for the Aquarium.[176] Originally trained as a dentist, Van Deusen had shifted gears early in life and became a highly respected ichthyologist specializing in tropical species of the Caribbean. He joined the staff of the Aquarium in 1916 and contributed substantially to its success over the years.[177]

Each tropical expedition took three to four weeks. They were not easy, but they were rewarding in terms of spectacular specimens brought back—blue, black, and French angel fish, red and Spanish hog fish, tropical sturgeon, red and rock hind, blue parrot fish, butterfly fish, and large groupers.[178]

At Key West, temporary slatted wood holding pens were anchored in the water along a pier. As fish were caught by contracted fishermen, or by Van Deusen himself on special forays into the Gulf of Mexico or Caribbean Sea, they were placed in the pens. When there was enough to bring home—between 1,200 and 1,500 specimens of between 50 and 60 species—the fish were transferred to fifteen or more large 200-gallon tanks made of wood and fitted with

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[174] "Dr. Van Deusen, Fish Expert, Dies," Philadelphia Inquirer (13 May 1946), 16.
[175] "Van Deusen Here for Aquarium Fish," *The Key West Citizen* (10 Jul 1940), 1.
[176] See for example "Seeks Rare Fishes in Tropical Seas," *Evening Bulletin* (8 Jul 1925); "Fish from Tropics Reach Aquarium," *Evening Bulletin* (23 Aug 1926); "Seeks Fish for Aquarium," *Evening Bulletin* (26 Jul 1927); "1,600 Rare Fish Reach Aquarium," *Evening Bulletin* (5 Aug 1932); "1,200 Rare Fish Arrive," *Evening Bulletin* (15 Aug 1933); "1,500 Aquarium Specimens Arrive," *Evening Bulletin* (13 Aug 1934); "1,400 Fish Arrive Here from South," *Evening Bulletin* (26 Jul 1935); "Aquarium Gets Rare Tropical Fish," *Evening Bulletin* (20 Aug 1938).
[177] "Dr. Van Deusen, Fish Expert, Dies," *Philadelphia Inquirer* (13 May 1946), 16; Van Deusen designed the municipal aquarium in Key West, which opened in 1935 (and is still operating today). In 1937 he was asked to design a research aquarium at the Philadelphia College of Pharmacy and Science. A year later, he gave an address at the dedication of the aquarium in Druid Hill Park in Baltimore, Maryland. See "Aquarium Director Sees Dream Unfold," *Philadelphia Inquirer* (9 Sep 1934), 2; "Aquarium History," *Key West Aquarium* (2011–2021) <www.keywestaquarium.com/aquarium-history>, accessed 3 Dec 2021; Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 15f; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 71; "The First Aquarium," *The Baltimore Sun* (22 Jan 1991), <www.baltimoresun.com/news/bs-xpm-1991-01-221991022219-story.html>, accessed 9 Dec 2021.
[178] *The Fish Culturist,* Vol. 5, No. 1, (Pennsylvania Fish Culturists' Association, Sep 1925), 6.

perforated covers. The tanks were secured on the open deck of a steamship for shipment to Philadelphia. Compressed air was fed to the tanks continuously during the voyage north. Sea water was pumped from the ocean and circulated among the tanks via hoses until the ship passed Cape Hatteras, North Carolina, north of which the water was too cold for the tropical fish.

At port in Philadelphia, the wood tanks were unloaded onto trucks and taken as quickly as possible to the Aquarium, where the fish were transferred to stock tanks where they could acclimatize to their new environment. This last transfer would take about an hour; during this time, compressors in the Aquarium would be used to force air into the tanks on the trucks.

The expeditions required great skill by Van Deusen and his team. Keeping the fish alive while they were being held in their pens at Key West was tricky. Even more difficult was keeping them healthy during shipment. Despite the expertise of the Aquarium personnel, up to half the specimens would be lost during the overall process.[179]

During this time, improvements were made to both the fresh and salt water supply. The municipal water that had been used in the freshwater exhibits since 1913 may have been clearer than the raw Schuylkill River water used prior to that, but it was just as injurious to the fish, if not more so. By 1914 the city's entire water supply was chlorinated to kill harmful bacteria, including the vectors that cause typhoid and cholera. Although the effective concentration of chlorine was low enough to be harmless to humans, to fish it was poisonous. Chlorine is very difficult to filter out, however, so another solution was pursued.

During the summer of 1925 a 500-foot-deep artesian well was drilled on the Aquarium

[179] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 7ff.

grounds and a pump was installed the following year.[180] The well had three problems, however.

First, the flow rate was disappointing. Although 500 gallons per minute were expected, only 75 to 100 gallons per minute were realized.

Second, the water was unexpectedly tainted with sewage, probably from a minor break in a nearby sewer. Since fish don't contract typhoid or cholera, though, Meehan and Fairmount Park officials were unconcerned.

What was perceived as a more pressing issue, however, was the third problem—a high iron content which began to stain the tanks. When the initial filters were insufficient;[181] Meehan switched to a single filter of larger total capacity in 1928.[182] The newer filter took care of the iron staining and had the side benefit of largely solving the sewage issue well.

The same year the steam-driven water pumps were replaced by two electrically driven pumps. Thereafter steam was used only for heating.[183] This allowed the boilers and steam equipment to be shut down during the warmer months, eliminating the costs of coal consumption and ash removal during that part of the year.[184]

Since the water drawn from the artesian well was relatively cold—52–54 degrees year-round—it was used in the tanks that held cold-water species like the various types of trout. The municipal supply tended to be warmer, especially in the summer, and was used in the tanks that

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[180] Fairmount Park Commission, *Chief Engineer's 1925 Annual Report* (31 Jan 1926), 8; "Aquarium Drills for Special Water for Use of Specimens," *Evening Bulletin* (15 Aug 1925); "City's Fish Thrive on Impure Water," *Evening Bulletin* (7 Feb 1927). The 1927 article states the well was drilled "at the side of the Aquarium, which is housed in the historic building of what was once the Fairmount Water Works." This suggests that the location of the well was likely in the area of the filled Forebay or in the northern end of the South Garden, close to the Engine House.

[181] Fairmount Park Commission, *Chief Engineer's 1927 Annual Report* (11 Jan 1928), 9.

[182] Fairmount Park Commission, *Chief Engineer's 1928 Annual Report* (9 Jan 1929), 3.

[183] Fairmount Park Commission, *Chief Engineer's 1928 Annual Report* (9 Jan 1929), 3.

[184] Fairmount Park Commission, *Chief Engineer's 1927 Annual Report* (11 Jan 1928), 9.

held warm-water species like bass, gar, and catfish.[185]

The condition of the Aquarium's sea water was looking up as well. Since the opening of the marine exhibit in 1916, sea water was barged in from Cape May at great expense. Beginning in 1926, however, the Moore & McCormack steamship company began delivering tropical sea water to Philadelphia nearly free of charge. This allowed Meehan to completely renew the water in the marine exhibit for the first time, and with not just any sea water but water taken from the Gulf Stream in the tropics.[186] This was much more suitable for the tropical marine fish that Van Deusen was obtaining for the Aquarium during his annual expeditions to Key West.

In time other steamship lines offered the service as well. The companies could do this because they typically transported more cargo in the southbound direction than the northbound, so sea water from the southern Gulf Stream was regularly pumped aboard for extra ballast during northbound trips. The water was offloaded when the ships arrived in Philadelphia. The Aquarium only had to pay for the cost of the pumping on either end of the trip."[187]

By this time, the Fairmount Park Aquarium was virtually built out and fully operational. The New Mill House contained the marine exhibit, the Old Mill House contained the freshwater exhibit, and the Engine House featured special exhibits as well as a lecture and meeting hall. It had taken its place as one of the four premier public aquariums in the world, alongside those in New York, London, and San Francisco. Measured by capacity, it was identified as "probably the largest."[188]

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185 William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 5.
186 "Ship Brings Salt Water From Gulf to Here for Use in Aquarium Tanks," *Evening Bulletin* (13 Apr 1926); "News of the Ships and Shipping Men," *Philadelphia Inquirer* (30 Aug 1926), 20.
187 William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 6ff.
188 William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4.

The Aquarium housed approximately 5,000 specimens at this time, around 3,000 of which were on display at any given time. The vast majority of the 200 or so species were fish, with aquatic reptiles, amphibians, and even a few insects rounding out the exhibits. [189]

There were 132 display tanks, with a total of 630 linear feet of display glass. Seventy of these were concrete side-wall tanks, each five feet in height and five feet deep from front to back. The remaining 62 were free-standing tanks of various smaller dimensions between one and six feet wide, some of which were all glass. Roughly two thirds of the side tanks were six feet wide and one third were seven feet wide. One was 12 feet wide and six feet deep from front to back; another was 16 feet wide and nine feet from front to back. The largest was 30 feet wide and 12 feet deep from front to back. With a capacity of 13,500 gallons, this last tank was the second largest aquarium display tank in the world, behind one in the public Aquarium in Brighton, England.[190]

In the working area behind the side tanks there were 43 concrete tanks for storage, reserve stock, and sick specimens, and numerous smaller tanks and receptacles. There were steam-driven and electrically driven air compressors and circulation pumps. Fresh water was drawn directly form the municipal supply and from the artesian well on the grounds.[191]

The sea water supply required more careful management. Brought in as ship ballast from the Gulf of Mexico, nearly 100,000 gallons was in active circulation. Nearly that much more was stored as reserve in large concrete tanks in the lower level of the Engine House. During the cold

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[189] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 6.
[190] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 4f.
[191] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 5.

months, the sea water was heated to between 72 and 76 degrees.[192] It was circulated by pumping it to 4,000-gallon tank located in the attic above the Superintendent's office in the Watering Committee Building. From this tank, the water flowed by gravity down to the display tanks at a pressure of approximately nine pounds. Below the display tanks, the water dropped about two feet through slotted pipes into a fast sand filter. From the filter, the water dropped into a 4,000-gallon-capacity pool. From the pool it was pumped back up into the tanks above the Superintendent's office to begin its journey again. All of the sea water was cleansed with each pass through the system. It was also naturally aerated four times—when it flowed into the display tanks, when it poured into the filter, when it fell into the pool, and when it was pumped up to the overhead tank. Compressed area was also delivered in the display tanks and the filter pool.[193]

Keeping specimens alive and healthy in any aquarium, large or small, has always been a difficult job. It requires skill and hard work. The Fairmount Park Aquarium was no exception.[194]

Fish are extremely sensitive to temperature. The water needed to kept within a rather narrow temperature range which varied according to the species. If the temperature departed from the tolerable range, or changed too quickly, fish were likely to die. Similarly, the salinity of the sea water had to be maintained within a narrow range as well.

Many species are finicky about what they eat. Some will only eat food from animal sources, for example, others only plant sources, and some will eat both. Some will eat only live food, some only dead matter, some only whole food, some only fragmentary. Of those that feed

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[192] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 5.
[193] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 6.
[194] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 9.

on other animals, some eat only one type such as crustaceans, say, or other types of invertebrates. The Aquarium staff had to take all of this into account as they fed the various species they maintained. Some of the foods used were live minnows, works, cut butter fish, weakfish, whiting, smelt, herring, clams, crabs, shrimp, and daphnia. Two plants used for food were sea moss and freshwater cabomba (fanwort).

Some species were fed daily and some twice per week. The food bill totaled between two and three hundred dollars per month.[195]

Fish are also subject to a variety of diseases and parasites; these are easily spread in captivity. All of the tanks and elements of the circulation system had to be kept scrupulously clean. "Hospital tanks" were used to isolate and treat sick fish.

All of the infrastructure needed to be kept in good operating condition. Maintenance was difficult in the high-moisture environment. Corrosion of the equipment was an ever-present problem, as was deterioration of the buildings themselves. There was never a lack of work. At least some staffers were always present, round the clock.[196]

Despite the efforts of the Aquarium staff, however, there was a persistent high mortality rate among the fish and other specimens.[197] It was eventually attributed to the restricted environment which stressed the animals and resulted in decreased resistance to communicable diseases and parasitic attack, both of which were more likely in the close quarters.[198] Other factors, however, more closely related to decisions by the Aquarium managers regarding the handling and treatment of the fish, sometimes caused unexpected die-offs. As early as 1917, for

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[195] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 9. The equivalent value in today's dollars is $3,200 to $4,900.
[196] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance,* souvenir booklet (Fairmount Park Commission, 1929), 5.
[197] Fairmount Park Commission, *Chief Engineer's 1928 Annual Report* (9 Jan 1929), 3.
[198] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 16.

example, some sort of infrastructure issue caused the death of 287 freshwater fish in June and an unspecified accident resulted in the death of 167 marine fish around the same time.[199] A high specimen mortality would continue to be a problem throughout the Aquarium's history.

Around this time there were a number of proposals that would have meant changes to the area surrounding the Aquarium.

In 1920 a recent uptick in traffic on the creaky Schuylkill Navigation system resulted in a briefly considered proposal for its wholesale renewal as a significant inland waterway. What little commercial activity that still took place was almost entirely coal shipments. Now owned by the Philadelphia and Reading Railroad, for a short time it became a convenient relief route for bypassing coal shipment bottlenecks in the rail system. Any significant improvement, however, would have needed to include widening and deepening of long stretches and enlargement of numerous locks. This had the potential to change the character of the lock system at the western end of the Fairmount Dam, but eventually improvements in the rail system made the prospect of improving the canal financially unattractive and idea was not pursued. The canal continued its sleepy twilight existence.[200]

The same year, Mayor J. Hampton Moore proposed the construction of a public beach in the area of the filled-in outer Forebay, between Fairmount Dam and Plaisted Hall,[201] the municipal recreation center at the southern end of Boathouse Row. Projected to cost just under $48,000,[202] architect Paul Philippe Cret had already worked up a design. Additional funds would

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199 Aquarium Superintendent to Chief Engineer, Fairmount Park, 26 Oct 1918. The Superintendent's report vaguely referred to "a shortage of both supply and pressure" in the case of the freshwater fish and "an unavoidable accident one night" in the case of the saltwater fish. The first may refer to either the water or air supply; it is anyone's guess as to what the second refers to.

200 "Schuylkill Canal Now Coming Back," *Philadelphia Inquirer* (1 Aug 1920), 4.

201 The oldest portion of Plaisted Hall had been built in 1881. See Larry Fish, "The New Resident on the Row," *Philadelphia Inquirer* (19 Aug 1997), 13. Plaisted Hall was demolished in 1994; the Lloyd Hall recreation center has occupied the site since 1998.

202 The equivalent of approximately $710,800 in 2022.

need to be spent to dredge the mud flats which had begun to develop in front of the area.[203]

Three years earlier a nationally prominent lawyer, John C. Johnson, had died and left his massive and highly esteemed art collection to the City of Philadelphia. City Councils had appropriated $125,000[204] to create a museum on the Fairmount Parkway dedicated to the collection.[205] The mayor proposed diverting some of this money to pay for the public beach.

There were a handful of privately operated beaches on the Delaware River in the Torresdale neighborhood, but there was nothing of the kind on the Schuylkill. “I want to provide,” declared the mayor, “some kind of open-air bathing for the thousands of persons who can’t spare the money for vacations at the seashore or far away in the country during the summer days.”[206] City Councils disagreed with the mayor, however, and rejected the diversion of funds.[207] The beach was never built.

The Fairmount Parkway was proposed at this time as a location for the Sesquicentennial Exposition, a world’s fair planned for Philadelphia for 1926. Selection of the Parkway site would have involved the construction of numerous buildings in the open spaces along the thoroughfare, behind the art museum, and in the Lemon Hill section of Fairmount Park. Many of the structures would have been permanent additions to the landscape. Developed by architect Paul Philippe Cret, the plan also included a bridge across the Schuylkill River to the Powelton neighborhood immediately to the west, a sports stadium near the Smith Memorial Playground and Playhouse

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[203] “Mayor Urges Using Johnson Gallery Fund for Beaches,” *Philadelphia Inquirer* (20 Jul 1920), 1.

[204] The equivalent of approximately $2.9 million in 2022.

[205] Joseph E. Widener, Peter A. B. Widener’s son, was a member of the Art Jury of the Fairmount Park Commission and had been working to keep Johnson’s collection separate from his late father’s collection. See David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 115.

[206] “Passage of Beach Bill is Demanded,” *Philadelphia Inquirer* (27 Jul 1920), 2.

[207] “Johnson Art Fund Remains Intact,” *Philadelphia Inquirer* (24 Aug 1920), 2. In an act of spite, Joseph E. Widener resigned from the Art Jury and eventually donated his father’s art collection to the National Gallery in Washington, D.C. instead of the Philadelphia Museum of Art. A separate museum for Johnson’s collection was never built; the collection instead became part of the Philadelphia Museum of Art.

near the East Park Reservoir, and an expansion of the Aquarium.[208] There fair was ultimately held, but a site in south Philadelphia was chosen instead.[209]

There was one positive residue of the Cret plan for the grounds surrounding the Aquarium. Although the area of the outer Forebay remained unimproved, the Italian government[210] donated the *Fountain of the Sea Horses* to the City at the time of the Sesquicentennial. The fountain was delivered too late for the fair, however, and was instead installed in 1928 in the center of a small traffic circle just to the north of the filled-in Forebay, behind the under-construction art museum and along the longitudinal axis of the art museum and Fairmount Parkway.[211] Since this was the route most people used to get to the Aquarium, it was a significant enhancement.

Often called simply the "Italian Fountain," it is a virtual copy of the 1840 *Fountain of the Sea-Horses* (*Fontana dei Cavalli Marini*) in Rome. Carved from Italian travertine marble, it features a lower basin with four sea horse which support an upper bowl and vertical jet. Each of the sea horses weighs 2½ tons and the upper bowl weighs eight tons.[212] Water also sprays out from between each of the sea horses' two legs. A dedicatory inscription is carved in both Italian and English on the coping stones around the edge of the basin. The English reads: TO THE AMERICAN NATION FROM THE ITALIAN NATION ON THE SESQUICENTENNIAL OF

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[208] "Parks Association Urges Cret Plan for 1926 Fair," *Evening Public Ledger* (7 Jan 1922), 1, 18; "Cret Site Urged for World's Fair," *Philadelphia Inquirer* (8 Jan 1922), 18.
[209] The Sesquicentennial Exposition was ostensibly a celebration of the 150th anniversary of the signing of the Declaration of Independence. Staged in South Philadelphia, as a "world's fair" it was less than successful.
[210] Led at the time by fascist dictator Benito Mussolini.
[211] "Fountain of the Sea Horses," *Association for Public Art* (2022), <www.associationforpublicart.org/artwork/fountain-of-the-sea-horses/>, accessed 9 Aug 2022.
[212] Ashley Hahn, "Italian Fountain Restored, Getting Ready to Splash Again This Summer," *WHYY: PlanPhilly* (31 May 2013), <https://whyy.org/articles/italian-fountain-restored-getting-ready-to-splash-again-this-summer/>, accessed 9 Aug 2022.

THE DECLARATION OF INDIPENDENCE [*sic*] 1776·1926.[213]

The Fairmount Park Commission still hoped in 1924 to build the proposed bridge across the Schuylkill River to Powelton. The Bridge was part of a larger proposal that would have included a park and boulevard along the west bank of the Schuylkill River from Spring Garden Street down past the Pennsylvania Railroad's planned new station at 30th Street all the way to Passyunk Avenue in south Philadelphia.[214] Neither the bridge nor the boulevard and park were built.

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By the late 1910s the Fairmount Dam—still the responsibility of the Bureau of Water—had again deteriorated to the point that significant repairs would be needed to prevent a catastrophic failure. Although the Fairmount Pool no longer supplied 96 percent of the city's water supply as it once did,[215] a large portion of the Philadelphia's population—all of West Philadelphia and about a quarter of the population east of the Schuylkill River—still relied on it.[216] If by reading thus far one would expect that the endeavor would be attended with extended drama, delay, danger, and finger-pointing—in other words, the usual *sturm und drang* associated with major projects in Philadelphia—one would be sadly correct.

Recall that the structure of the dam was composed of enormous cribs or cages[217] consisting of interlocking wood logs filled with large-sized crushed rock. The nature of the

[213] Yes, the word "independence" is misspelled. Most never notice. See Ruth Seltzer, "They're Giving a Present to Fairmount Park," *Philadelphia Inquirer* (4 Jun 1967), 107, and personal observation by author-editor.
[214] "Park Body Plans Schuylkill Bridge," *Evening Bulletin* (21 Mar 1924).
[215] Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), table at 39. Table lists the amount of water pumped by each of the stations from 1854 to 1873.
[216] "Biles Seeks Bids On Fairmount Dam," *Philadelphia Inquirer* (24 Jan 1924), 12.
[217] Often called gabions today.

design and materials meant that it needed significant periodic maintenance. Completed in 1822,[218] portions of the original structure were already deteriorating just twenty years later. Everything above the low-tide water line was replaced in 1843.[219] By the 1860s much of the foundation cribbing was found to be insecure or missing altogether. Some of the remaining wood was sagging and some of the rock fill had washed away. A new rock-filled wood crib structure was completed across the deepest part of the downstream face of the dam in 1866.[220]

In 1873 a rock-filled wood crib structure was completed across the entire downstream face of the dam. It was intended that the space between the old and new structures was to be filled with concrete but unbeknownst at the time, the contractor instead used simple earthen fill topped with a thin veneer of concrete to hide the deceptive work.[221] By 1889, portions had again deteriorated and a section of the new downstream structure broke away during a flood and was carried downstream. It was retrieved and resecured, and the entire dam had rock and rotted timbers replaced. Rotted timbers were again replaced in 1900.[222]

By 1902 the shoddy work in 1873 had begun to result in significant damage to the structure. The concrete veneer over the fill between the old and new structures had begun to break apart, allowing water to course through the space, wash out much of the fill, and push the lower structure away from the upper structure, widening the gap between them. In 1906 a two-

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[218] Watering Committee, *1821 Annual Report* (24 Jan 1822); Watering Committee, *1849 Annual Report* (3 Jan 1850), chart at 28 ("Statistics Relating to Fairmount Water Works"); Watering Committee, *1852 Annual Report* (6 Jan 1853), 4; *Plan of Mill Buildings at Fairmount, designed by F. Graff 1819,* Collection of The Franklin Institute.

[219] Watering Committee, *1843 Annual Report* (4 Jan 1844), 5; Michael Towers, *Report of the Superintendent for Rebuilding the Fairmount Dam* (16 Dec 1843), appended to 1843 Annual Report; Water Department, *Chief Engineer's 1864 Annual Report* (2 Feb 1865), 19.

[220] Water Department, *Chief Engineer's 1865 Annual Report* (15 Feb 1866), 11f, 62, 78, 79f; Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 14f, 77.

[221] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 90, 98; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 89f; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 70; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 101.

[222] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 82.

year, $25,000[223] repair project was completed. Rock fill was replaced, all missing and defective timbers were replaced, the entire downstream apron was resurfaced with new wood, and the space between the upper and lower structures was filled with concrete.[224]

Maintaining Fairmount Dam's stability had become a perennial headache. During the winter of 1916 the structure sustained serious damage from ice during a flood event. Carlton E. Davis, Chief of the Bureau of Water at the time, began to formally recommend that the entire thing just be replaced once and for all.[225] "Action should not be delayed until the dam becomes unsafe," Davis noted in his annual report, "but the integrity should be safeguarded before the danger period is reached."[226]

In the spring of 1918 the dam was again severely damaged by ice. City Council appropriated $45,000 for repairs,[227] less than Davis requested. After as much work as the money would allow had been accomplished, Davis was still concerned that it was not good enough and recommended replacing Fairmount Dam with a "permanent masonry structure."[228] The following year he fretted that the structure was "not in good condition" and said that if funds for replacement were not provided, further repairs to the existing structure would again be necessary.[229]

Fairmount Dam was increasingly recognized as vulnerable. In September of 1920, Mayor J. Hampton Moore sent to Council a report from a board of engineers which recommended

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[223] The equivalent of approximately $822,700 in 2022.
[224] Bureau of Water, *Chief Engineer's 1904 Annual Report* (19 Jan 1905), 83; Bureau of Water, *Chief Engineer's 1905 Annual Report* (19 Jan 1906), 59; Bureau of Water, *Chief Engineer's 1906 Annual Report* (26 Jan 1907), 61.
[225] Bureau of Water, *Chief Engineer's 1916 Annual Report* (31 Dec 1916), 10.
[226] Bureau of Water, *Chief Engineer's 1916 Annual Report* (31 Dec 1916), 4.
[227] The equivalent of approximately $882,600 in 2022.
[228] Bureau of Water, *Chief Engineer's 1918 Annual Report* (8 Jan 1919), 9; "City to Rebuild Schuylkill Dam," *Philadelphia Inquirer* (24 Jul 1921), 2.
[229] Bureau of Water, *Chief Engineer's 1919 Annual Report* (5 Dec 1919), 6.

immediate reconstruction. City Council[230] created a $33 million "general improvement loan"[231] and carved out a special appropriation of $3.5 million[232] for improvement of the water supply system. Council intended for some of this amount to be spent on a new Fairmount Dam, but instead it was virtually all spent on improving of the water supply in the northern and northwestern areas of the city.[233]

Despite prioritizing other water infrastructure improvements,[234] the Bureau of Water did manage the following summer to make test borings in order to characterize the bedrock conditions along the length of the dam and facilitate the engineering design of a new dam.[235] Davis estimated at this time that a concrete dam would cost $750,000[236] and take a year and a half to construct. He indicated the design would incorporate subsurface circular sluices which would create new currents that would scour away the deposits of mud which had formed in front of Boathouse Row and elsewhere along the east shore of the river. The sluices also had the benefit of being easily fitted in the future with turbines for electrical power generation.[237]

Mayor Moore requested from Council a special appropriation of $800,000[238] in May 1922.[239] Two days later the editorial staff of the *Philadelphia Inquirer* exhorted, "A new dam is a necessity, and the time to build it is now. … There should be no conflicting opinion among the Councilmen concerning this matter. Come on! Let's get started."[240] Within a month the City's

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[230] Beginning in 1919, a new city charter changed City Council from a bicameral to a unicameral body.
[231] The equivalent of approximately $489 million in 2022.
[232] The equivalent of approximately $51.8 million in 2022.
[233] "Council to Speed New Fairmount Dam," *Philadelphia Inquirer* (14 Dec 1922), 6.
[234] "$5,259,915 in Work to Improve Water," *Philadelphia Inquirer* (11 Dec 1921), 29.
[235] Bureau of Water, *Chief Engineer's 1921 Annual Report* (10 Jan 1922), 4; "City to Rebuild Schuylkill Dam," *Philadelphia Inquirer* (24 Jul 1921), 2.
[236] The equivalent of approximately $12.4 million in 2022.
[237] "Dam In Schuylkill Will Cost $750,000," *Philadelphia Inquirer* (18 Aug 1921), 3. Recall that Chief Engineer Henry P. M. Birkinbine had wanted to install a chute to allow fish to pass through the dam in 1865, but no such structure was incorporated at that time.
[238] The equivalent of approximately $14.1 million in 2022.
[239] "Research Bureau Urges Start on Fairmount Dam," *Evening Public Ledger* (20 Apr 1922), 4.
[240] "A New Dam for the Schuylkill [editorial]," *Philadelphia Inquirer* (25 Mar 1922), 12.

Bureau of Municipal Research chimed in, urging a speedy start to construction.[241] That October the mayor asked Council to approve a $6.9 million loan[242] for numerous items including $750,000 for reconstruction of Fairmount Dam, but Council rejected the proposal because the borrowing capacity for the year was nearly exhausted. "It is too late for a loan now," Finance Committee Chairman Joseph P. Gaffney complained. "The time expired last week and now we are asked to wipe out the small Councilmanic borrowing capacity which remains to us. It is so low that if there was any great catastrophe to be met in this city, the margin available probably would not be enough."[243]

The condition of the dam wasn't improving during the delay. In November the editorial staff of the *Philadelphia Inquirer* put it starkly if sensationally:

> [The Fairmount Dam] is in a highly dangerous condition. An unusual ice condition or an extraordinary flood would carry it away. The only protection it has had from destruction is the bank of silt that has grown up behind it. That is a mighty poor crutch to lean upon. If anything happens to that crutch the end of the dam will have come.
>
> And the end of the dam would be the end of any supply of water to an enormous territory in West Philadelphia.
>
> …
>
> What we are doing is calling the attention of the city authorities—and especially of the members of the City Council—to a fact that cannot be denied or belittled. That fact is that a very large section of the city is seriously menace—is dangerously menaced—is actually threatened with the loss of all water.
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> If that Fairmount Dam—weak, leaky—is torn away by ice or flood, thousands upon

241 "Research Bureau Urges Start on Fairmount Dam," *Evening Public Ledger* (20 Apr 1922), 4.
242 The equivalent of approximately $122 million in 2022.
243 "Councilmen Balk at $6,900,000 Loan Proposed by Mayor," *Philadelphia Inquirer* (6 Oct 1922), 1.

> thousands—tens of thousands upon tens of thousands—of residents will have to be abandoned for lack of water and a vast area will be left open to destruction by fire.
>
> We are putting this matter strongly because there is need to arouse the Councilmen to action. A new dam to take the place of the existing flimsy barricade is absolutely necessary.[244]

Councilman Charles B. Hall objected to City Council being blamed for the delay. He accused the administration of insisting on the inclusion of a footbridge which the Fairmount Park Art Jury refused to approve. "Meanwhile," Hall reminded everyone, "the $3,500,000 of the loan funds we appropriated for improvement of the water supply was used for other purposes than replacement of the dam." Water Bureau Chief Davis denied the dispute and claimed the concept of a pedestrian walkway had been considered but been abandoned early on. "I don't know of any controversy. The footbridge over the dam would be impractical because the piers on which it would be placed would reduce the net length of the dam over which water could flow."[245]

Director of Public Works Frank H. Caven backed up his Water Bureau Chief, insisting that while the initial design for the dam had indeed incorporated a footbridge along the top, the department's own engineers had "decided that the heavy pillars or abutments would slow up the water and cause trouble in the event of a freshet or heavy rainfall up-State. The footbridge idea then was abandoned." There could be no quarrel with the Art Jury, Caven continued, because the plans for the dam had not yet been submitted to it. He did admit that Council had given the go-ahead to build the dam with funds already provided for water supply system improvements, which Council would later reimburse, but that the

[244] "A New Fairmount Dam Absolutely Necessary [editorial]," *Philadelphia Inquirer* (21 Nov 1922), 12.
[245] "City Water System is Praised by Davis," *Philadelphia Inquirer* (2 Dec 1922), 3.

department had dedicated those funds instead to "improvements to pumping stations and filter beds."[246]

Throughout the latter part of the year, Theodore Justice and the other Fairmount Park Commissioners, together with numerous prominent citizens, had been aggressively lobbying members of Council to do something to break the procedural logjam. Councilman Hall responded that Council could pass an ordinance providing $600,000 for the dam.[247] "This money can be taken out of the sum appropriated for pay of the police or any other similar large item," Hall said, "and can be replaced easily through a loan." He issued a statement designed to show that Council understood the urgency of the situation:

> The emergency is a real one. A break in the badly weakened dam would mean that every home in West Philadelphia with the exception of a part of Overbrook would have to go without water. The work should be commenced in earnest no later than the first of the year.
>
> Let the administration send along its plans and Council will do its share toward providing against the menace caused by the fifty-year-old leaky dam. We are satisfied that further delay is attended with peril to hundreds of thousands of our people Responsibility for such delay will not rest upon our shoulders. The one great need is action, prompt action.
>
> Philadelphia has the money to pay for this improvement. There will be enough coming in through added taxes to pay for it. An ice jam or a great spring flood will almost surely tear away a large section of the present structure. By giving Chief Davis a free hand and turning his engineers loose by the first of the year, they will be able to guard against such a calamity.[248]

The problem was that Moore's administration did not want to take the money for the

[246] "Says Lack of Funds Blocks Fairmount Dam," *Evening Public Ledger* (2 Dec 1922), 3.
[247] The equivalent of approximately $10.6 million in 2022.
[248] Richard J. Beamish, "New Fairmount Dam of Greatest Need, Say City Officials," *Philadelphia Inquirer* (6 Dec 1922), 1, 7.

dam out of the capital, maintenance, or payroll budgets for any of its departments, even temporarily. Apparently no one trusted City Council to replace the funds in a timely fashion. The administration demanded a special appropriation just for the dam. Mayor Moore sent Council a letter from the Director of Public Works. "No action has been taken by Council," Caven scolded, continuing:

> The Bureau of Water has had plans and specifications ready for months to go ahead with this construction, and also the approval of the State authorities and of other bodies having power to pass upon the plans. The preliminary borings have been made and there is no reason why the construction of this dam should not be under contract at the very earliest date, so that the contractor could assemble his plant and materials and start the construction immediately after the flood period in the spring is past.[249]

City Council was having none of it. Finance Committee Chairman Joseph P. Gaffney insisted he had personally discussed paying for the dam out of funds from the big infrastructure improvement loan with Director Caven in 1920 and had believed that was what Caven was going to do.[250] Council President Richard Weglein continued to maintain that Council had given the Bureau of Water all the money it needs to reconstruct the Fairmount Dam but it had instead chosen to spend it on other things—needful things, but other things of their choosing nonetheless:

> We provided for this and any other urgent improvements required for the betterment of the city's water supply in the $3,500,000 item from the $33,000,000 loan long ago. That money has been spent for other purposes, though the necessity for a new dam has been under constant agitation and plans and specifications were prepared for it. The only thing we can do now is to provide an earmarked item. However, we get nowhere with

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[249] "Council Decides to Get Action On Dam," *Philadelphia Inquirer* (8 Dec 1922), 4.
[250] "Council Decides to Get Action On Dam," *Philadelphia Inquirer* (8 Dec 1922), 4.

recriminations. My plan is to get results and have less talk about it. The Committee on Public Works to which I am referring this communication should call for a showdown. Is the dam to be built? When can it start? How long will the work take and how much will it cost? …

> We expected the dam at Fairmount would be rebuilt out of the big water item in the $33,000,000 loan. … Council did all it possibly could in this matter, but the dam has not been built. Now apparently we will have to start all over again.[251]

Calling Fairmount Dam "a growing menace," Mayor Moore again demanded a speedy appropriation of funds. Ahead of any special appropriation, City Council passed an ordinance authorizing the administration to award construction contracts. The Council President explained that although he expected Council to eventually pass an appropriation, reconstruction work could be started without delay in the meantime, since the administration could pay for it immediately out of maintenance funds and be reimbursed later from a loan created by City Council. That, however, was exactly what the administration was loathe to do.

Weglein again threw the diversion of the 1920 funds back in the mayor's face. Of the $33 million "general improvement loan" in 1920, City Council had made a "special appropriation" of $3.5 million "for extension and improvement of the water supply," Weglein reminded all involved. Council had intended for some of this appropriation to be spent on a new Fairmount Dam, but instead it was virtually all spent on improvement of the water supply in the northern and northwestern sections of the city. "The money was spent judiciously without a doubt," Weglein conceded in an attempt to sound conciliatory, "but nevertheless the fact remains that our intention was not carried out. So that there will be no

[251] "Council Decides to Get Action On Dam," Philadelphia Inquirer (8 Dec 1922), 4.

slip next time I propose specific earmarking of any appropriation so that it cannot be spent for anything else but the dam."[252]

In March 1923, Council proposed a $5 million loan[253] which included a $750,000 earmark[254] for reconstruction of Fairmount Dam.[255] The next month, while the loan proposal was still working its way through the legislative process, Councilman Hall submitted a resolution to authorize the Director of Public Works to advertise immediately for bids on Fairmount Dam ahead of the passage of the loan so that contracts for the construction could be let as soon as the money became available. Mayor Moore responded that although he was heartily in favor of the reconstruction of the dam, he thought Hall's resolution was highly presumptuous and an interference with his authority.[256]

Council passed Hall's resolution authorizing advanced bids just eight days after it was introduced,[257] but Mayor Moore vetoed it, saying he thought Council was trying to claim credit for an achievement that belonged to the administration. Councilman Hall and Finance Committee Chairman Gaffney were livid. Hall called the veto "silly" and pointed out that the mayor's own Director of Public Works thought it was a good idea. Gaffney said that if "reckless talking was punishable by the same means as reckless driving, the Mayor would spend the rest of his life in jail."[258]

The loan proposal was finally passed by Council in April 1923. Though reduced to $3.61 million[259] from the initial $5 million, Mayor Moore immediately signed it into law. True to

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[252] "Council to Speed New Fairmount Dam," *Philadelphia Inquirer* (14 Dec 1922), 6.
[253] The equivalent of approximately $86.6 million in 2022.
[254] The equivalent of approximately $13 million in 2022.
[255] "Councilmanic Loan to Total $5,000,000 Being Considered," *Philadelphia Inquirer* (7 Mar 1923), 1.
[256] "Mayor Hits Hall's Plan," *Philadelphia Inquirer* (12 Apr 1923), 6.
[257] The *Philadelphia Inquirer* published the text of the resolution a week after the mayor vetoed it. See "City Ordinances," *Philadelphia Inquirer* (27 Apr 1923), 22.
[258] "Council Leaders Attack Mayor When Latter Asks for Appropriation," *Philadelphia Inquirer* (20 Apr 1923), 8.
[259] The equivalent of approximately $62.5 million in 2022.

Council President Weglein's word, however, it retained a special earmark for $700,000[260] for the reconstruction of Fairmount Dam.[261] Throughout the summer, however, the legality of Council's borrowing capacity—and with it the money for the dam—was in dispute in the courts.[262] With the funds being held up, and the construction of the dam needing to be done during the time of year when the water in the river was low, Mayor Moore did the very thing that the ordinance he earlier vetoed would have enabled him to do. He instructed the Director of Public Works to advertise for bids in advance of having the funds in hand. Bids were taken and the low bid, for $623,000,[263] was submitted by the McLean Construction Company of Baltimore, Maryland. By the time the contract could be awarded and let, however, the low-water period had passed and construction had to put off until the following year.[264]

In the municipal election in the fall of 1923, both Council President Weglein and Finance Committee Chairman Gaffney failed re-election. W. Freeland Kendrick was elected mayor, taking office on 7 Jan 1924. With a new composition of members, Council introduced a bill for a special appropriation of $700,000 for reconstruction of Fairmount Dam.[265] Although the ordinance had yet to pass, Mayor Kendrick consulted with the leadership of City Council and then authorized his recently appointed Director of Public Works, George H. Biles, to advertise for bids on the Fairmount Dam contract. Biles signed off on final approval of the dam's engineering plans and issued a Request for Proposals (RFP) on 23 Jan 1924.[266]

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[260] The equivalent of approximately $12.1 million in 2022.
[261] "$5,000,000 Loans Signed by Mayor," *Philadelphia Inquirer* (12 May 1923), 2. Council approved two loans totaling over $5 million. The $3.61 million loan was the one with the earmark for the dam.
[262] "Council Prepares for Supreme Court Test of New Loans," *Philadelphia Inquirer* (8 Jun 1923), 1.
[263] The equivalent of approximately $10.8 million in 2022.
[264] "Dam Rebuilding Plan Abandoned for Year," *Philadelphia Inquirer* (24 Jul 1923), 3.
[265] "Bus Route Bills Appear in Council," *Philadelphia Inquirer* (18 Jan 1924), 2
[266] "Biles Seeks Bids On Fairmount Dam," *Philadelphia Inquirer* (24 Jan 1924), 12. Biles' Request for Proposals (RFP) hit the newspapers the next day. See "Sealed Proposals Will Be Received," *Philadelphia Inquirer* (24 Jan 1924), 26.

Two days later Council passed the bill appropriating $700,000 for Fairmount Dam and authorizing construction; five days after that, Mayor Kendrick signed the legislation.[267] The editorial staff of the *Philadelphia Inquirer* was optimistic:

> The present dam has been defective for years, and we have it on the authority of the Fairmount Park engineer that only the great deposit of silt above the dam keeps it from being washed away[268]… We had much talk about it during the closing days of the last administration. It should have the right of way now, and the mayor and the City Council could perform a real public service by taking up this unfinished business and rushing it to completion.[269]

The Department of Public Works received five bids. When they were opened on 14 February[270] the lowest bid, at $604,650,[271] was from Seeds & Derham, a general contracting company in Philadelphia specializing in bridges and dams.[272] The contract was awarded on 20 February and specified a deadline for completion of 1 Dec 1925, encompassing two construction seasons. Work finally got under way soon after.[273]

One of the necessities of the construction involved the dismantling of the Pier. Recall that what we tend to think of as the Fairmount Dam is actually only the overfall portion of the entire Fairmount Dam system which is composed of, from west to east, the Schuylkill Navigation

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[267] "Pay for Highway Employees Voted," *Philadelphia Inquirer* (26 Jan 1924), 7; "An Ordinance to Authorize the Construction of the Fairmount Dam," *Philadelphia Inquirer* (4 Feb 1924), 24.

[268] There was probably some truth to this. In 1922 the Fairmount Park Commission said that the large amount of silt which had accumulated directly behind the dam had protected it and was a significant factor in the dam's surviving destruction during a massive ice jam in 2020. For this reason, the Commission had avoided dredging immediately behind the dam. See "Dam Is Safe Until New One is Built," *Philadelphia Inquirer* (10 Dec 1922), 14.

[269] "Urgent Need of the New Fairmount Dam [editorial]," *Philadelphia Inquirer* (22 Jan 1924), 12.

[270] "Water Mains to Be Construction New Building Operations," *Philadelphia Inquirer* (14 Feb 1924), 8.

[271] The equivalent of approximately $10.5 million in 2022.

[272] See for example "Memorandum: Seeds & Derham to Stoneyhurst Quarries, 29 Aug 1933," collection of Montgomery County Historical Society, Rockville, Maryland, *Digital Maryland* (2022), <https://collections.digitalmaryland.org/digital/collection/mhqu/id/28>, accessed 22 Apr 2022.

[273] "Award Dam Contracts," *Philadelphia Inquirer* (21 Feb 1924), 4. The second highest bid, $622,400, was from the Frederick Snare Contracting Company.

system's lock system (the current location of the Fairmount Fish Ladder), the overfall portion, the Pier, the Mound Dam with its embedded New Mill House, and the Old Mill House. The Pier forms the eastern anchor for the overfall portion.

When the Fairmount Dam was originally constructed in 1822, the plan of the Pier (in other words, when seen from above) was nearly square. When an additional crib structure was added to the front of the overfall portion in 1873, it had the effect of widening the dam from front to back. The Pier was lengthened at that time, to the familiar shape it is today, so it could continue to function effectively as an anchor for the eastern end of the overfall portion of the dam.[274] During construction in 1925, the southern end of the Pier was temporarily dismantled so that the tie-in with the overfall portion, with its new concrete addition, could be modified. It was then re-assembled block by block.[275]

Early in the construction, a workman on the project named Fred Lucas discovered a handgun during excavation. Judging from the photograph published locally at the time, it was a Johnson & Bye Defender. Manufactured from 1871 to 1899, the .32-caliber, five-shot, spur-trigger revolver was an example of what was often called a "suicide special,"[276] one of numerous small, relatively inexpensive models produced by a variety of manufacturers during the late nineteenth century. It would not have had a serial number/ All five of the chambers were loaded but one of the cartridges had been fired. There are more questions about the gun than answers, however. Whose was it? Why was it discarded in the river? Was it used during the commission

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[274] Water Department, *Chief Engineer's 1872 Annual Report* (30 Jan 1873), 90, 98; Water Department, *Chief Engineer's 1873 Annual Report* (5 Mar 1874), 89f; Water Department, *Chief Engineer's 1874 Annual Report* (8 Apr 1875), 70; Water Department, *Chief Engineer's 1875 Annual Report* (6 Apr 1876), 101.

[275] "Working On Fairmount Park Dam [photograph and caption]," *Philadelphia Inquirer* (31 Mar 1925), 17.

[276] So-called because the cheaply made weapons were apt to be as dangerous to the shooter as to the target. The term was coined in 1948 by author Duncan McConnell. See Duncan McConnell, "Suicide Specials," *American Rifleman* (National Rifle Association, Feb 1948), 36ff; Donald Blake Webster, Jr., *Suicide Specials* (Harrisburg, Pennsylvania: Stackpole Books, 1958).

of a crime? Who or what was it shot at? Was it disposed of during one of the episodes of major construction on the dam, say, in 1873, 1889, or 1906, perhaps during the night when no one would be working? An immense construction site like that would certainly be a handy place to get rid of a gun. The true story will likely never be known.[277]

As late as July of 1925, construction was still projected to be complete by the original deadline. Unexpected delays caused problems, however, and the work wasn't finished until late 1926.[278] By March of 1927, all of the residual details had been completed.[279] The new portion of the dam was a 1,050-foot-long, solid concrete structure constructed against the downstream face of the old dam, without sluices or a footbridge.[280] With very little maintenance, it still serves its water supply and recreational purposes today.

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In 1927 a landmark powerhouse on the eastern bank of the Schuylkill River just below the Callowhill Street Bridge was repurposed for use as a heating plant for both the Aquarium and yet-to-be-finished art museum. Noted for its tall smokestack, it had originally been built by the Pennsylvania Door and Sash Company. Part of the building was demolished and rebuilt around the boilers within. The partial reconstruction also allowed for a realignment of the Callowhill Street and Spring Garden Street approaches to the eastern end of the lower and upper decks, respectively, of the double-deck Callowhill Street Bridge, located at the southern end of the

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[277] "Mystery Revolver Found," *Philadelphia Inquirer* (6 Nov 1924), 17.
[278] Bureau of Water, Chief Engineer's 1926 Annual Report (31 Dec 1926), 213.
[279] "City Art Museum Viewed From the River," *Philadelphia Inquirer* (13 Mar 1927), 5; "Rich Waters of Spring Pour Merrily Over the New Fairmount Dam," *Philadelphia Inquirer* (14 Mar 1927), 15.
[280] Richard J. Beamish, "New Fairmount Dam of Greatest Need, Say City Officials," *Philadelphia Inquirer* (6 Dec 1922), 1, 7; "Biles Seeks Bids On Fairmount Dam," *Philadelphia Inquirer* (24 Jan 1924), 12.

South Garden.[281]

The following year the new home of the Pennsylvania Museum and School of Industrial Art—today known as the Philadelphia Museum of Art—was completed atop Fairmount.[282] Collaboratively designed by Horace Trumbauer, Paul Cret, Julian Abele,[283] and Howell Lewis Shay in the form of an elaborate, E-shaped Greco-Roman temple, it debuted to the press on 3 Jan 1928. After being toured by invited guests throughout the month of March, the new art museum was opened to the public on 27 Mar.[284]

The decks of the Old Mill House and New Mill House had long been troublesome. In 1930 they were resurfaced with rolled stone grit and asphalt oil in an attempt to make them waterproof.[285] The panes in the skylights were replaced with one-foot-square, heavy plate glass, set in wood frames.[286]

A new sewer beneath East River Drive, north of Fairmount, was approved by City Council on 12 Jun 1928 and constructed from July 1930 to December 1931. It was intended to relieve nearby sewers during storm water surges. At its southern end it diverged from the alignment of East River Drive and passed, below grade, to the filled Forebay just north of the Forebay Bridge. At this point the sewer split into three branches.

One branch passed beneath the filled outer Forebay and Mound Dam and emptied into the Schuylkill River at the downstream side of the Mound Dam. The second branch emptied into

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[281] Fairmount Park Commission, *Chief Engineer's 1927 Annual Report* (11 Jan 1928), 2.
[282] Often shortened to the "Pennsylvania Museum," the name would be formally changed to Philadelphia Museum of Art in 1938.
[283] In 1902 Abele was the first African American to be graduated from the Department of Architecture of the University of Pennsylvania.
[284] David B. Brownlee, *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), 68.
[285] Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3.
[286] Fairmount Park Commission, *Chief Engineer's 1929 Annual Report* (8 Jan 1930), 3; Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3.

the river at a point between the New Mill House and Old Mill House.

The third branch continued southward beneath the Forebay Bridge and into the filled inner Forebay. At the southern edge of the Forebay it made a curved, ninety-degree turn to the west and connected with the flume of the 1851 turbine. This allowed the contents of the sewer to empty into the river through the turbine's tail race between the Old Mill House and the Engine House. Unfortunately, in order to make the connection work, most of the internal components—including the moving and stationary blades—of the only remaining turbine from the Fairmount Water Works' days as a water pumping facility were removed and destroyed.[287] It was probably at this time that a portion of the turbine's flywheel was encased in concrete, preventing any movement of the turbine components.[288] During construction of the sewer, the thick glass panes of several of the Aquarium's tanks were cracked by vibrations from blasting and had to be replaced.[289]

The unfortunate locations of the sewer outflows created in another problem for the Aquarium. The back-and-forth action of the tides below Fairmount Dam caused the discharged sewage to stagnate in the area instead of being washed down the river. This resulted in chronic foul odors around Fairmount, hardly a desirable situation for a public attraction.[290]

During the summer of 1931 the Aquarium's six-inch municipal water supply line ruptured where the new sewer was being constructed beneath it at the south end of the inner Forebay. Before the water was shut off, the outflow eroded a hole in the fill ten feet wide and twelve feet deep near the northeast corner of the Engine House. The supply line was repaired the

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[287] Department of Public Works, *Main Relief Sewer Through Fairmount Park*, blueprint (Philadelphia: 1928); *Minutes of Board of Surveyors* (5 May 1930); Jane Mork Gibson, *Removal of Machinery during Construction of Sewer through 1851 Turbine Installation in 1930–1931* (1986). The internal components of the turbine were likely sold for scrap.
[288] Manitou Machine Works, Inc. to Matheu Cebul and Associates, 15 Mar 1986.
[289] Fairmount Park Commission, *Chief Engineer's 1931 Annual Report* (13 Jan 1932), 3.
[290] Frederic V. Lewis, "Silt Turns River Into an Eyesore," *Philadelphia Inquirer* (7 Nov 1944), 19.

next day. In the meantime, Aquarium staff increased the amount of compressed air they introduced into the water, while the supply of fresh water was cut off.[291]

The Aquarium continued to experience problems with specimen mortality. A spike in 1937 was caused by stress on some of the fish while relocating them during reconstruction of a number of exhibit tanks. The fish population was reduced that year from 1,520 to 856.[292] Three years later, two night attendants were fired when 120 tropical fish died after the men failed to properly maintain the air and water circulation.[293]

Significant improvements to the grounds were made at this time. Most visitors came to the Aquarium along Aquarium Drive, off East River Drive in the area behind the Art Museum. The *Fountain of the Sea Horses,* for example, had been a visual focal point since 1926, but it wasn't until 1931 that the area immediately behind the Art Museum was graded to slope down toward the fountain and the Schuylkill River. This had been the location of the North Garden, where the demolition and excavation rubble from the reworking of the top of Fairmount had been temporarily placed. The rubble was now used to create an artificial landscape at a higher elevation than the erstwhile North Garden had been. The slope from the rear of the Art Museum down to the fountain was aligned with the axis of the parkway between the Art Museum and City Hall. Boulders were arranged to create an artificial hill between the slope and East River Drive.[294] The result was that any trace of the North Garden was obliterated.

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[291] "Aquarium Fish Periled by Break," *Evening Bulletin* (8 Jun 1931); "Aquarium Fish Saved," *Evening Bulletin* (9 Jun 1931).
[292] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 11ff, 15. Dead specimens were regularly donated to various institutions for study, but that didn't help the Aquarium.
[293] "Dead Fish Cost Two Jobs," *Evening Bulletin* (4 Nov 1940).
[294] This is the area in which a sculpture garden and partially below-grade parking garage was completed in 2009. See "Philadelphia Museum of Art," *Pennoni* (2021), <www.pennoni.com/project/philadelphia-museum-of-art/>, accessed 19 Apr 2021; "The Philadelphia Museum of Art—Sculpture Garden and Parking Garage," *Structure Tone Organization* (2021), <https://structuretone.com/projects/the-philadelphia-museum-of-art-sculpture-gardern-and-parking-garage/>, Accessed 19 Apr 2021; "Philadelphia Museum of Art Parking Garage," *Pierce Engineering Inc.*

The grounds around the Art Museum saw the planting of 46 trees, 3,900 shrubs and vines, 2,600 evergreen plants, 1,900 herbaceous perennials, and 8,750 privet hedge plants. The roadways behind the Art Museum—including Aquarium Drive—were paved with Filbertine. [295]A year later the area of the filled-in outer Forebay—between the *Fountain of the Sea Horses*, the New Mill House, and the Schuylkill River—was graded and landscaped with grass, hedges, and flowering plants.[296]

In 1932, however, a decrease in City Council's appropriation to the Fairmount Park Commission began to make itself felt, resulting in a cutback in landscape upkeep throughout the Fairmount Park system. When the Fairmount Park workforce found it impossible to maintain in a desirable condition the newly improved grounds around the Art Museum and Aquarium, a decision was made to concentrate on the east front and courtyard of the Art Museum.[297] This area did not include South Garden, Cliffside Paths, or any of the grounds around the Fairmount Water Works.

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On the day after New Year's Day, 1930,[298] Superintendent William E. Meehan died suddenly of heart failure at the age of 76, a few months after celebrating the fiftieth anniversary

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(2021), <www.pierceenngineering.com/index.php/philadelphia-museum-of-art-parking-garage>, accessed 19 Apr 2021.

[295] Fairmount Park Commission, *Chief Engineer's 1931 Annual Report* (13 Jan 1932), 3. Filbertine was a proprietary type of asphalt pavement. "R. Y. Filbert's Improved Waterproof Filbertine Paving Cement" consisted of asphalt, ¾-inch crushed rock, sand, and stone dust. See Arthur H. Blanchard, ed., *American Highway Engineers' Handbook,* 191, (New York: John Wiley & Sons, Inc., 1919), 900f.

[296] Fairmount Park Commission, *1932 Annual Report* (11 Jan 1933), 4.

[297] Fairmount Park Commission, *1932 Annual Report* (11 Jan 1933), 3.

[298] "Obituary: William E. Meehan," *Philadelphia Inquirer* (4 Jan 1930), 5.

of the marriage to his wife Linda Meehan.[299] The mayor[300] appointed Robert O. Van Deusen, Meehan's assistant, to replace him.[301] Van Deusen sought to build upon Meehan's success by providing for a "more scientific care and feeding of the fish and of the observation of the chemical constitution of the water."[302]

In many ways the Fairmount Park Aquarium came into its own in the 1930s. At over 4,300 in 1932, the specimen population was at an all-time high.[303] In addition to the freshwater fish indigenous to Pennsylvania, the list of exhibited species grew to include fish and crustaceans such as giant groupers, blue and green parrot fish, snapper fish, blue spotted and golden moray eels, electric eels, porcupine fish, drum fish, trigger fish, African lungfish, Japanese walking fish, remora, tarpon, moon fish, long- and short-nosed gar, striped bass, marine catfish, nurse sharks, sea horses, king crabs, and spider crabs. Amphibians and aquatic reptiles and included giant salamanders, Japanese salamanders, African water frogs, water snakes, snapping turtles, loggerhead turtles, and alligators.[304] There was even an exhibit of aquatic insects for a time.[305]

The public responded. Adults and children alike crowded in. Schoolchildren visited during field trips. In addition to viewing the exhibits, adults attended lectures. It became a family favorite.

These were the Aquarium's most popular years. This was perhaps due in part to the wide

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[299] Daniel Shaw, "William E. Meehan: An AFS Legacy Builder," *Fisheries* (Taylor & Francis, for American Fisheries Society, 4 Aug 2020), 427ff.
[300] Harry Arista Mackey was mayor at the time. See "Mayors of the City of Philadelphia," *Department of Records, City of Philadelphia* (13 Jan 1998), <www.phila.gov/phils/mayorlst.htm>, accessed 9 Dec 2021.
[301] Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3.
[302] Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3.
[303] Fairmount Park Commission, *Chief Engineer's 1932 Annual Report* (11 Jan 1933), 3. There were 4,126 fish, 42 invertebrates, 102 amphibians, and 126 reptiles. Total number of specimens: 4,396.
[304304] Numerous Fairmount Park Commission *Annual Reports* refer to specific species in the collection. See for example Fairmount Park Commission, *Chief Engineer's 1931 Annual Report* (13 Jan 1932), 4; Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 13; Fairmount Park Commission, *1943 Annual Report* (Jan 1944), 37; Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 26.
[305] Fairmount Park Commission, *1947 Annual Report* (Jan 1948), 40.

attention enjoyed by public aquariums during this period. It didn't hurt that it was an admission-free diversion for a society in need of such things during the Great Depression.

Acclaimed as a world-class leader among municipal aquariums, one of the best of its type,[306] the Aquarium attracted visitors from every state (including then-territories Alaska and Hawaii) and around the world. "Our Aquarium," Superintendent Van Deusen could justifiably declare at the close of the decade, "has taken its place among the other large aquariums of the world."[307]

In addition to its being entertaining, the Aquarium could boast of its educational value as well.[308] The list of countries represented by school groups alone was impressive—Canada, Mexico, Cuba, Panama, Brazil, Chile, Argentina, Britain, Germany, Belgium, and Japan.[309] In 1930 a record for school children was reached when 3,745 students representing 63 schools visited in a single day.[310] In addition to viewing the exhibits, visitors attended regularly scheduled lectures on aquatic vertebrate and invertebrate zoology given by Van Deusen and his staff.[311]

The superintendent addressed numerous clubs, civic associations, and educational organizations meeting in the grand hall of the Engine House.[312] During the Christmas season in

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306 For an account typical of the period, see "Philadelphia's Aquarium Is One of World's Best," *Record* [Philadelphia] (24 Aug 1939).
307 Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 69.
308 Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3; Fairmount Park Commission, *Chief Engineer's 1936 Annual Report* (13 Jan 1937), 14.
309 Numerous Fairmount Park Commission *Annual Repor+-ts* refer to specific locations. See, e.g., Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 70; Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 33; Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 35; Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 35.
310 Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 14.
311 For example Fairmount Park Commission, *Chief Engineer's 1934 Annual Report* (9 Jan 1935), 6f.
312 For example Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 17; Fairmount Park Commission, *Chief Engineer's 1936 Annual Report* (13 Jan 1937), 14; Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 13, 14; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 71, 72; Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 70f; Fairmount Park Commission,

1937, Van Deusen gave a radio talk on local station WDAS.[313] Fishing enthusiasts and sporting goods merchants often brought specimens in for identification.[314] Annual attendance peaked at just over a million in 1933 and continued to hover around 700,000 each year until 1942.[315]

In addition to entertainment and education, Superintendent Van Deusen sought to facilitate the advancement of scientific knowledge.[316] Beginning in 1935, for example, the Aquarium maintained 75 king, spider, lady, and horseshoe crabs for the use of Dr. H. K. Hartline, of the University of Pennsylvania's Eldridge Reeves Johnson Foundation for Medical Physics, in his investigation of the physiology of vision.[317] Dr. Richard Weissenberg of The Wistar Institute was given access to certain specimens in 1938 and 1939 for his study of intracellular parasitism.[318] In 1940 the Aquarium made its catfish population available to the

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1940 Annual Report (Jan 1941), 46; Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 43. The groups included the Camp & Trail Club, Dover Fishing Club, Junior Zoölogical Society, Pennsylvania Fish Culturists Association, Delaware Valley Naturalists Union, Greater City Aquarium Society of Astoria (Long Island), Germantown Academy, Philadelphia College of Pharmacy and Science, graduating class of the University of Pennsylvania Veterinary College, Girard College, Delaware County Institute of Science, Board of Education Meeting on Visual Education, Philadelphia Council of Museums, Humane Society of Baltimore, Ladies' Civic Club of Philadelphia, Descendants of the Mayflower, Rotary Club of Key West, Boy Scouts Council of Philadelphia, Comstock Society of Philadelphia, Optimists Club, and various local Lions Clubs, PTAs, veterans groups, and church groups.

313 Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 16. WDAS was an early radio station in Philadelphia. Van Deusen's talk was arranged by the local Shut In Society.

314 Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 17; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 73.

315 Fairmount Park Commission, *Annual Reports, 1912–1958* (8 Jan 1913–Jan 1959), collection of Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation. In a 1914 letter to a colleague, Meehan had optimistically predicted that annual attendance would eventually top out between 1½ to 2 million. See Meehan to J. W. Gage, Secretary of Chicago Fish Fanciers' Association (14 Dec 1914).

316 Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 18; Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 15; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 72f; Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 71f; Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 47; Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 44.

317 Haldan Keffer Hartline (1903–1983) was a distinguished professor and researcher in the field of visual physiology. He went on to become a co-recipient of the Nobel Prize for Physiology or Medicine in 1967 for his groundbreaking contributions to the understanding of the biochemical and physiological processes of vision. See Floyd Ratliff, *Haldan Keffer Hartline: A Biographical Memoir* (Washington, D.C.: National Academy of Sciences, 1990); "Keffer Hartline," *The Nobel Prize* (2021), <www.nobelprize.org/prizes/medicine/1967/hartline/biographical/>, accessed 20 Dec 2021.

318 German-born research scientist Julius Richard Weissenberg (1882–1974) fled Nazi Germany for the United States in 1937. Associated with numerous institutions over his career, he was a professor at The Wistar Institute

University's Dr. Balduin Lucké for cancer pathology research.[319] Even notable specimens that died were donated for study to institutions such as The Phipps Institute,[320] The Wistar Institute,[321] Temple University, and the Biology Department of the University of Pennsylvania.[322]

The Aquarium achieved an impressive level of success despite the handicap of operating in a location as problematic as the Fairmount Water Works. Located low and close to the Schuylkill River, and filled with tanks of water, the high-humidity environment made maintenance and upkeep a nightmare. This was especially true in the saltwater environment of the exhibit area in the New Mill House. The infrastructure needed constant work. The public spaces seemed to always be in need of repair, replastering, and repainting.[323]

The location along the river also meant that the Aquarium was prone to flooding. A

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from 1937 to 1940. Intracellular parasitism was his lifelong focus. See for example Richard Weissenberg, "Microsporidian Interactions with Host Cells," *Comparative Pathobiology, Vol. I: Biology of the Microsporidia,* Lee A. Bulla, Jr., and Thomas C. Cheng, eds. (Springer, 1976), 203ff, biographical sketch at 237.

319 Unfortunately, Lucké's work at the Aquarium was discontinued when his responsibilities as a colonel in the U.S. Army Medical Corps took him away two years later. See Fairmount Park Commission, *1942 Annual Report* (Jan 1943), 41; Colonel Balduin Lucké, "The Army Institute of Pathology During World War II," *The Military Surgeon,* Vol. 99, Issue 5 (AMSUS, Nov 1946), 364ff. Later a Chairman of the Department of Pathology at the University of Pennsylvania, the Balduin Lucké Memorial Prize was established in his honor in 1960 and is awarded to students in the School of Medicine completing a superior research project on a problem in the field of experimental medicine and biology. See "Graduation Awards and Prizes," *Perelman School of Medicine, University of Pennsylvania,* (2021), <www.med.upenn.edu/student/graduation-awards-and-prizes.html>, accessed 20 Dec 2021.

320 Established in 1903, The Phipps Institute was instrumental in the research and development of a cure for tuberculosis, especially in the African-American population. See David McBride, "The Henry Phipps Institute, 1903–1937: Pioneering Tuberculosis Work with an Urban Minority," *Bulletin of the History of Medicine,* Vol. 61, No. 1 (Johns Hopkins University Press, Spring 1987), 78ff; "Institutions," University of Pennsylvania (2021), <www.sas.upenn.edu/hss/microbio/insts3.html>, accessed 21 Dec 2021.

321 Founded in 1892 and located in Philadelphia, the Wistar Institute is renowned for its contributions in the fields of oncology (cancer research) and immunology. It played a key role in the development of rubella, rabies, and rotavirus vaccines. The well-known Wistar rat, the first standardized laboratory animal model, was developed by the Institute in the early twentieth century. See "About Wistar," *The Wistar Institute* (2021), <https://wistar.org/about-wistar/our-story>, accessed 21 Dec 2021.

322 Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 15; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 72; Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 71; Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 44.

323 Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 12; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 70f.

severe flood event occurred on 23 Aug 1933. The Chesapeake-Potomac Hurricane[324] brought up to ten inches of rain to the area and caused the Schuylkill River to crest at 14.7 inches above the Fairmount Dam, the second highest level since the river rose to 17 feet above the dam during the historic Saxby Gale Hurricane 64 years earlier in 1869.[325] Although the flood waters did not overtop the display tanks, the supporting machinery was incapacitated and the tanks' water and air stopped circulating. This resulted in the loss of a large portion of the fish.

The receding waters left behind a coating of mud on everything and eight inches of it on the floors. The Philadelphia Fire Department provided large water pumps which were used to wash away the mud and debris. The Philadelphia Electric Company (PECO) furnished an air compressor, without charge, which aerated the water and kept the surviving fish alive for over four and a half days while the Aquarium's equipment was being repaired. Even after the replacement of many of the specimens, however, the fish population dropped to 2,753 at the end of the year.[326]

Nearly two years later, in July 1935,[327] the Aquarium was again flooded. Once more the Fire Department hosed out the mess and again PECO provided an air compressor to aerate the water in the tanks.[328] Although this time there was no loss of fish, the two flood events served to call into question Fairmount's suitability as a location for a large working aquarium.

In 1937 a two-year renewal of the marine exhibit area in the New Mill House was begun.

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[324] George M. Mawhinney, "Storm Leaves 40 Dead; Two Killed in Phila., Loss Totals Millions," *Philadelphia Inquirer* (25 Aug 1933), 1, 7.

[325] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1.

[326] Fairmount Park Commission, *Chief Engineer's 1933 Annual Report* (9 Jan 1934), 5; "Firemen Clear Aquarium," *Evening Bulletin* (25 Aug 1933); "Aquarium Reopens, All Fish Saved," *Evening Bulletin* (28 Aug 1933).

[327] John M. McCollough, "Floods Hit City, State; Toll Heavy," *Philadelphia Inquirer* (10 Jul 1935), 1, 4, 5; "Floods Wane, Leave 12 Dead, Huge Damage," *Philadelphia Inquirer* (11 Jul 1935), 1, 4.

[328] Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 16; "Aquarium Fish Nearly Drown," *Evening Bulletin* (9 Jul 1935); Aquarium Fish Still Get the Air, *Evening Bulletin* (10 Jul 1935).

All of the display tanks were dismantled and reconstructed, the thirteen on the north or upriver side during the first year and the twelve on the south or downriver side during the second. The elaborate sheet-copper façades were replaced with concrete. The interiors of the tanks were modified to simulate natural settings of rock and reef formations. All of the old freshwater tanks in the center of the room were removed. Circulating pipes were replaced with piping featuring hard rubber valves and connections intending to eliminate the accumulation of verdigris[329] which was suspected of contributing to specimen mortality. Unfortunately, the necessary shifting back and forth of the fish had the unintended consequence of killing a large percentage of the marine population.[330]

The remainder of the New Mill House interior was repainted, the walls in ivory and the ceiling in sky blue. All of the work was done in-house by Aquarium and other Fairmount Park workers. The one exception was "Tank No. 3, a large, back-of-the-house, seawater storage tank composed of stone, brick, and concrete, which was repaired by WPA workers and painted by Aquarium workers. The funds for the work came from the savings realized when the annual specimen collection expedition to Key West was cancelled for the purpose.[331]

Other work was also performed by Aquarium employees as well. Workers reset the deck skylight panes that were installed just seven years prior and cleaned and repainted the frames.[332] The entire cast-iron balustrade along the river side, from the Callowhill Street Bridge to the Fairmount Dam, was repaired.[333]

Some of the work was contracted out. Saltwater circulating pumps and foot valves were

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[329] Copper chloride (in a saltwater environment).
[330] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 12.
[331] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 11f; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 70.
[332] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 12.
[333] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 11.

overhauled and repaired by a hired plumber.[334] It was a constant challenge keeping up with the cost- and labor-intensive maintenance. The Chief Engineer of the Fairmount Park Commission noted that no matter how much was done, there was always much more to do, especially in the marine exhibit area in the New Mill House. Saltwater vapor caused rapid and continuous deterioration of metal, woodwork, and painted surfaces, requiring constant maintenance and repair.[335]

In a reflection of a shift of resources, and likely in an effort to prevent further deterioration,[336] in November of 1937 William Rush's carved cedrela[337] *Allegory of the Schuylkill River in Its Improved State* and *Allegory of the Water Works* were removed from their positions over the North and South Entrance Portals, respectively, and Mercury was removed from the finial of the Mercury Pavilion. The three were provided to the art museum on long-term loan.[338] Three years later, the bronze cast of Rush's *Allegory of the Schuylkill River* was removed from the Central Marble Fountain in the South Garden for long-term loan to the art museum as well.[339] All four sculptures were subsequently displayed in the museum from time to time over

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[334] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 12.
[335] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 12.
[336] As early as 1914, Superintendent Meehan had expressed concern regarding the condition of Rush's sculptures over the Entrance Portals and the difficulties in properly maintaining them. That year he had the paint burned off the sculptures and assessed their deterioration. See Meehan to Jesse T. Vogdes, Chief Engineer of the Fairmount Park Commission (2 May 1914). At some point they were repainted in white, matching their original appearance.
[337] Spanish cedar.
[338] Minutes of Meeting of Fairmount Park Commission (14 Oct 1936). Single provenance card for accessions 12-1937-1, *Allegory of the Schuylkill River in Its Improved State,* 12-1937-2, *Allegory of the Water Works,* 12-1937-3, *Wisdom,* 12-1937-4, *Justice,* and 12-1937-5, *Mercury,* (29 Nov 1937), archives of Philadelphia Museum of Art. On 14 Oct 1936 the Fairmount Park Commission agreed to a request from the Museum of Art for a long-term loan for an exhibit on William Rush the museum expected to hold in February of 1937. Rush's *Mercury* was also removed from the roof of the Mercury Pavilion and loaned to the museum, probably around this time.The loan also included Rush's sculptures *Wisdom* and *Justice*, which were standing in the main room of the first floor of the Engine House at the time. The portal sculptures had been mounted atop the Entrance Portals since 1825. Mercury had stood atop the Mercury Pavilion since 1829. The paint was removed from the portal sculptures by Art Museum staff in 1939.
[339] Provenance card for accessions 29-1940-1, *Allegory of the Schuylkill River* (1940), archives of Philadelphia Museum of Art. The sculpture had graced the Central Marble Fountain since 1872. The loan was made official in 1940. See Temporary Receipt from Philadelphia Museum of Art, 22 Jul 1940, and Permanent Receipt from Philadelphia Museum of Art, 24 Sep 1940, Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation.

the years.[340]

Despite the funding issues, some maintenance work was performed during this time. In 1933 the cast iron fence at the southern end of the South Garden, designed and installed by Frederic Graff, Jr. just after the death of his father in 1847, was repaired.[341] The Eagle Pavilion was rebuilt in 1939 and the flagstone deck was re-laid. The cast iron balustrade surrounding the Pier and Eagle Pavilion was replaced and one hundred feet of pipe railing was constructed along the sides of the Mound Dam.[342] In 1940 a set of stone steps was constructed from Aquarium Drive at the east end of the Forebay Bridge to the grassy slope behind the art museum. While not a monumental undertaking, to be sure, it was built by Works Projects Administration workers and paid for with federal funding.[343] The same year red gravel was spread on at least one of the Cliffside Paths.[344]

Interior fluorescent lighting began to be installed in 1940, replacing the original incandescent fixtures, but the transition wasn't finished until after the war.[345]

In August of 1941 the Fairmount Park Commission installed extensive exterior lighting, including accent lighting under the Pavilion, Eagle Pavilion, and porches, as well as on deck areas and balconies, and a dramatic wash of light upon the entire building complex from floodlights mounted on the west bank of the Schuylkill River.[346] The dramatic new lighting not only highlighted the beauty of the Fairmount Water Works, but it also served to increase

[340] Minutes of Meeting of Fairmount Park Commission (14 Oct 1936); C. H. Bonte, "Recalling William Rush, First American Sculptor," *Philadelphia Inquirer* (7 Mar 1937), 76.
[341] Fairmount Park Commission, *1933 Annual Report* (9 Jan 1934), 5.
[342] Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 31, 69.
[343] Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 36. Created in 1935, the Works Progress Administration was renamed the Works Projects Administration in 1939.
[344] Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 36, 37.
[345] Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 45; Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 34.
[346] Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 24.

nighttime safety after several sexual assaults on the grounds had been recorded on the police blotter.[347] The floodlights were at first mounted low on the river bank, but after apartment dwellers near the eastern shore complained that the bright lights were shining into their homes, the lights were moved to poles.[348]

Unfortunately the new lighting would all be extinguished some four months later as the the nation decisively entered World War II in response to the Japanese attack on Pearl Harbor on 7 Dec 1941 and the German declaration of war against the United States four days later. As anti-air raid measures were implemented, Philadelphia—like cities and towns across America—went dark.

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347 "'Dangerous Area Now Floodlighted," *Philadelphia Inquirer* (2 Aug 1941), 13; "A New Philadelphia Nocturne: Schuylkill Floodlights [photograph]," *Philadelphia Inquirer* (2 Aug 1941), 10.
348 "Aquarium to Have New Floodlights," *Philadelphia Inquirer* (4 Nov 1941), 36.

CHAPTER 12

DECLINE OF THE AQUARIUM

It is difficult to understate the degree to which World War II had an adverse effect on the Aquarium. The effects were not only harmful but long-lasting.[1] The war caused permanent logistical changes which disrupted the acquisition of the two components foundational to any aquarium, aquatic species and suitable water. In this case, the specifics were tropical marine fish and sea water.

Prior to World War II, steamship companies typically transported more cargo in the southbound direction than the northbound, so sea water from the southern Gulf Stream was regularly pumped aboard for extra ballast during northbound trips. When the ships arrived in Philadelphia, the Aquarium could have the seawater ballast "for the asking."[2] Aquarium took advantage of this arrangement for the first time in 1926.[3] Between 1929 and 1935, the Moore & McCormack steamship company donated between 28,000 and 60,000 gallons of sea water each year.[4] Between 1937 and 1941, the Merchants and Miners Transportation Company offloaded from its ships between 28,000 and 160,000 gallons, depending on the year, all free of charge.[5]

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[1] Morley Cassidy, "Fish Fall on Evil Days," *Evening Bulletin* (27 Oct 1956), 6.
[2] *Fairmount Park Aquarium* (1929), 4 (photograph), 5 (photograph), 6ff.
[3] "News of the Ships and Shipping Men," *Philadelphia Inquirer* (30 Apr 1926), 20.
[4] Fairmount Park Commission, *Chief Engineer's 1929 Annual Report* (8 Jan 1930), 3; Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3; Fairmount Park Commission, *Chief Engineer's 1929 Annual Report* (8 Jan 1930), 3; Fairmount Park Commission, *Chief Engineer's 1931 Annual Report* (13 Jan 1932), 4; Fairmount Park Commission, *Chief Engineer's 1932 Annual Report* (11 Jan 1933), 3; Fairmount Park Commission, *Chief Engineer's 1933 Annual Report* (9 Jan 1934), 4; Fairmount Park Commission, *Chief Engineer's 1934 Annual Report* (8 Jan 1935), 7; Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 17f. All donations reported in tons have been converted to gallons. Sea water weighs 8.556 pounds per gallon.
[5] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 14f; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 71; Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 72; Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 46; Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 43f.

Others such as the Southern Steamship Company[6] and the Standard Fruit & Steamship Company[7] contributed as well.

The war altered this pattern, however.[8] Shipping lines now had more northbound cargo than prior to the war, so their ships no longer needed to bring aboard water for ballast. Free deliveries of sea water became increasingly difficult to obtain. The last one was in 1941 and they were not resumed after the war.[9]

Aquarium staff tried at first using freshwater with simple table salt added as a replacement for the sea water. When that didn't work, sea water was brought in from Atlantic City on the coast of New Jersey. Sporadically during the war years and until 1948, the Steel Pier donated smaller quantities of sea water. The Atlantic City Fire Department pumped sea water at the Steel Pier into flushing trucks from Philadelphia's Department of Public Works' Bureau of Street Cleaning for transport to the Aquarium. Between 9,800 and 43,200 gallons were shipped in each year in this way.[10]

By 1949, it was suspected that poor-quality sea water was contributing to an ongoing high mortality rate among the marine specimens. This seemed to be confirmed by chemical analysis when compared with samples taken off the New Jersey coast. Further tests of samples from various sources identified the filtered sea water used by the Haddon Hall Hotel in Atlantic

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[6] Fairmount Park Commission, *Chief Engineer's 1934 Annual Report* (8 Jan 1935), 7.

[7] Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 71; Fairmount Park Commission, *1939 Annual Report* (Jan 1940), 72. The reader may recall that along with the United Fruit Company, Standard Fruit would wield significant influence over the governments of several Central American counties which became known as "banana republics."

[8] Wayne Robinson, "War Reaches the City's Fishes," *Evening Bulletin* (30 Sep 1941); "War Hits Fish in the Aquarium; Bars Water from Gulf Stream,' *Evening Bulletin* (27 Jan 1942); "Aquarium Hit By War," *Evening Bulletin* (20 Apr 1943).

[9] Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 43f.

[10] Fairmount Park Commission, *1942 Annual Report* (Jan 1943), 40.; Fairmount Park Commission, *1943 Annual Report* (Jan 1944), 37.; Fairmount Park Commission, *1945 Annual Report* (Jan 1946), 34.; Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 43. The annual report for 1948 mentions a "Maryland Avenue Pier," but the only structure there was (and still is) the nearby Steel Pier.

City as the best of the lot.[11]

Approximately 50,000 gallons was purchased and transported to the Aquarium in rented tank trucks in 1949, with the intention of replacing the entire supply of sea water when a sufficient quantity had been accumulated, roughly 150,000 gallons.[12] This was accomplished in 1951; the entire sea water supply, throughout all of the tanks and circulating system, was completely replaced.[13] In 1952 136,000 gallons were brought in, enough to create a substantial reserve.[14]

The expense of purchasing and transporting sea water from Atlantic City after having it virtually delivered to the door for nothing, however, added greatly to the financial burden of the Aquarium.[15]

In addition to the cost, quality problems still plagued the supply. In September of 1954, after two shipments of filtered sea water totaling 68,000 gallons were delivered from Atlantic City, hydrogen sulfide gas was detected in the Aquarium's sea water storage area. Tests confirmed that the water was contaminated by sewage. A follow-up investigation revealed that some of the trucks used to transport the water had previously hauled sewage and were not washed out prior to carrying the sea water. The entire reserve supply had to be discarded and the storage tanks cleansed. A little over a month later, sea water deliveries resumed, topping out at 95,000 gallons of useable supply by the end of November.[16]

World War II disrupted the supply of tropical marine fish even more than it did the supply of sea water. Prior to the war, many tropical fish had come from Key West fishermen

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[11] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43.
[12] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43.
[13] Fairmount Park Commission, *1951 Annual Report* (Jan 1952), 30.
[14] Fairmount Park Commission, *1952 Annual Report* (Jan 1953), 37.
[15] Henry L. Davis, "Deteriorating Plant May Force City to Shut Down Aquarium," *Evening Bulleting* (1 Oct 1950).
[16] Fairmount Park Commission, *1954 Annual Report* (Jan 1955), 35.

who would collect specimens, especially in the spring.[17] Superintendent Van Deusen personally conducted collection expeditions to Key West nearly every year for two decades,[18] some lasting over two months.[19] At the end of an expedition, as we have seen, Van Deusen would bring home up to 1,500 specimens, at times representing over a hundred species,[20] in water-tight, wooden tanks secured to the deck of a steamship.[21]

In 1940, however, a shuttered U.S. Navy installation just east of the main business and residential area was re-established as Naval Base Key West. It became a critical center from which anti-submarine warfare—crucial in protecting the homeland during the war—was conducted. In 1945 a number of nearby facilities from which aerial operations were conducted were consolidated into the base; the combined installation was renamed Naval Air Station Key West.[22]

With the increased military activity, the ships of the coastal shipping lines avoided the

[17] Fairmount Park Commission, *Chief Engineer's 1929 Annual Report* (8 Jan 1930), 3; Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 3; Fairmount Park Commission, *Chief Engineer's 1932 Annual Report* (11 Jan 1933), 3; Fairmount Park Commission, *Chief Engineer's 1933 Annual Report* (9 Jan 1934), 4; Henry L. Davis, "Deteriorating Plant May Force City to Shut Down Aquarium," *Evening Bulleting* (1 Oct 1950).
[18] "Dr. Van Deusen, Fish Expert, Dies," *Philadelphia Inquirer* (13 May 1946), 16.
[19] For example "Rare Fish Sought for Park," *Philadelphia Inquirer* (1 Aug 1921), 11; "800 Tropical Fish Come to Fairmount Aquarium," *Philadelphia Inquirer* (30 Jul 1922), 37; "Goes to Caribbean Sea for Rare Fish," *Philadelphia Inquirer* (18 Jul 1926), 55; "Aquarium Tank Bursts," *Philadelphia Inquirer* (17 Jul 1928), 2; "Fairmount Expert to Comb Caribbean for Grotesque Fish," *Philadelphia Inquirer* (30 Jun 1929), 25; "Phila. Expedition Goes to Key West for Fantastic Fish," *Philadelphia Inquirer* (29 Jun 1930), 25; "2800 Tropical Fish Collected for Phila.," *Philadelphia Inquirer* (29 Jul 1940), 20.
[20] For example Fairmount Park Commission, *Chief Engineer's 1934 Annual Report* (9 Jan 1935), 6; Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 18; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 70, 73Van Deusen had developed a close working relationship with the citizens of Key West. The staff of the Key West Aquarium occasionally donated tropical marine species to the Fairmount Park Aquarium. See for example Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 18.
[21] William E. Meehan, *The Fairmount Park Aquarium: Its History and Maintenance*, souvenir booklet (Fairmount Park Commission, 1929), 3ff; "Rare Tropical Fish Placed On Exhibit at Fairmount Park," *Philadelphia Inquirer* (28 Jul 1929), 23, 26. Van Deusen and his team accomplished this at no insignificant risk to their personal safety, by the way. During the 1938 expedition, for example, Van Deusen and his engineer, William Richards, were caught in two successive hurricanes. See Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 70, 73.
[22] "History," *Commander, Navy Region Southeast: Naval Air Station Key West* (2021), <www.cnic.navy.mil/regions/cnrse/installations/nas_key_west/about/history.html>, accessed 8 Apr 2021.

area. By the end of 1941 the collecting of tropical fish off Key West had ceased.[23] This meant that the Aquarium was forced to rely upon collections from the New Jersey coast as the sole source of replenishment for its marine exhibits. The northern species, however, tend to be far less colorful than those found in or near the tropics and are less of a draw for visitors.

In 1946 the Aquarium suffered an organizational disruption. On 12 May Superintendent Van Deusen died after suffering a stroke a month earlier.[24] Exactly one month later the mayor[25] appointed Harry R. Lindaman, the Assistant Superintendent since 1940,[26] as his replacement.[27] A recognized expert in pisciculture—he was a long-time secretary of the Pennsylvania Fish Culturists Association[28]—Lindaman inherited an Aquarium facing increasing challenges.

After the war, shipping practices did not return to pre-war patterns. Shipping lines operating from Philadelphia either gave up intracoastal service or had so few ships on a schedule so tight that they could not spare a call at Key West. Transport by rail or air, however, required constructing or purchasing special equipment which was cost-prohibitive in relation to the benefit.[29] The reliance upon New Jersey coastal species continued into the late 1940s.

Despite these difficulties, a few of the exhibits were truly exceptional. One of the giant groupers was the largest in captivity. At least 12 years old when it was acquired from the New

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[23] Fairmount Park Commission, *1942 Annual Report* (Jan 1943), 42; Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 33; Morley Cassidy, "Fish Fall on Evil Days," *Evening Bulletin*, (27 Oct 1956).
[24] "Dr. Van Deusen, Fish Expert, Dies," *Philadelphia Inquirer* (13 May 1946), 16.
[25] Bernard Samuel was mayor at the time. See "Mayors of the City of Philadelphia," *Department of Records, City of Philadelphia* (13 Jan 1998), <www.phila.gov/phils/mayorlst.htm>, accessed 9 Dec 2021.
[26] "Civic Leaders Rally to Save 'Stepchild' Aquarium," *Philadelphia Inquirer* (15 Oct 1956), 19; See Fairmount Park Commission, *1940 Annual Report* (Jan 1941), 46.
[27] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 34; "Action Postponed on Aquarium Head," *Philadelphia Inquirer* (24 May 1946), 19.
[28] "50 Fish Culturists Will Exhibit Here," *Philadelphia Inquirer* (13 Sep 1931), 26; "Obituary: Harry R. Lindaman," *Philadelphia Inquirer* (23 Jul 1968), 34.
[29] Fairmount Park Commission, *1947 Annual Report* (Jan 1948), 38f.

York Aquarium in 1941,[30] it thrived in Philadelphia, growing to 575 pounds before dying of old age in 1948.[31] One of the loggerhead turtles weighed 240 pounds.[32] A mangrove snapper fish was the largest in captivity in 1942.[33] In 1945, a pair of the marine catfish spawned, for the first time in captivity. After the female laid "a few large eggs," the male carried them in his mouth until 14 young were hatched.[34]

The difficulties in obtaining tropical specimens, however, began to have a negative effect on the marine population. In 1948 many notable saltwater specimens died of old age. The last three Green Moray Eels, collected in 1935, died, as did a six-foot-long Jewfish, acquired from the New York Aquarium in 1941 after having been exhibited in New York for 12 years prior to that. None of these were replaced.[35]

At the same time, there were increasing challenges collecting marine specimens off the New Jersey as well. In 1945 the Federal Government began to allow commercial fishing operations to net fish closer to shore. This resulted in net hauls of fish from the Million Dollar Pier that were of such poor quality that none were brought back to the Aquarium that year.[36] The first collection trip of the following year was so disappointing that no further attempts were made during the season.[37]

In 1947 twelve separate outings resulted in the collection of only 1,589 specimens

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[30] Fairmount Park Commission, *1941 Annual Report* (Jan 1942), 42, 44. The New York Aquarium had temporarily relocated to the Bronx Zoo from its longtime home in Castle Clinton in lower Manhattan's Battery Park when construction of the Brooklyn-Battery Tunnel threatened to undermine the foundation of the building. Although in the end the fears were unrealized, it wasn't until 1957 that the aquarium would move to its present location at Coney Island in Brooklyn. See "History of the New York Aquarium," *New York City Department of Parks & Recreation* (2021), <www.nycgovparks.org/about/history/zoos/ny-aquarium>, accessed 6 Dec 2021.
[31] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 44.
[32] Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 26.
[33] Fairmount Park Commission, *1942 Annual Report* (Jan 1943), 39.
[34] Fairmount Park Commission, *1945 Annual Report* (Jan 1946), 35.
[35] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 44.
[36] Fairmount Park Commission, *1945 Annual Report* (Jan 1946), 32.
[37] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 34.

altogether, only ten percent of which survived more than a few months. This was attributed to hauls of less hardy species and injuries from rough handling.[38] The next year Aquarium staff interviewed 82 "party boatmen and commercial fishermen" but found that none were equipped to capture live fish or keep them alive after capture. Neither would any consider chartering their boats for expeditions.[39] "At no time in the history of the Aquarium," Superintendent Lindaman wrote after surveying the collection attempts of 1948, "has it been so difficult to get specimens for the exhibits."[40]

The Aquarium had always suffered from a high mortality rate which made maintaining the fish population a challenge.[41] The increasing difficulties of replacing marine specimens of any sort, but especially the dramatic tropical species, just made the problem worse.

After studying various options, Lindaman decided to try air transport from Florida despite the cost. After being collected, fish were shipped from Miami as freight on Eastern Airlines passenger aircraft. Eleven shipments were made in 1949, carrying a total of 373 fish of 18 species. A discouraging 30 percent died in transit.[42]

The relatively high mortality was caused by two factors. First, the airline required the fish to be shipped in sealed, eighteen-inch cans. Naturally suffocation was a problem. Second, neither Eastern nor any other airline flew a direct route from Miami to Philadelphia. They all had a layover at National Airport, across the Potomac River from Washington, D.C. When the layover was short, most fish survived the trip. When air traffic was heavy and the layover was longer, however, most died. Some of the surviving specimens, moreover, arrived so weak that they died

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[38] Fairmount Park Commission, *1947 Annual Report* (Jan 1948), 39.
[39] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 42.
[40] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 42.
[41] For example Fairmount Park Commission, *1928 Annual Report* (9 Jan 1929), 3; Fairmount Park Commission, *1937 Annual Report* (12 Jan 1938),16.
[42] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 44f.

shortly after delivery.[43]

Results the following year were even less promising. Only a little over ten percent survived transport.[44] Shipping fish in small, sealed containers was clearly not viable.

Air transport was tried again in 1951, this time using an experimental method of continual aeration while en route. On the first attempt, the fish were in transit for 22 hours instead of the scheduled seven. Because of space limitations, however, the aerator system was designed to operate for only ten hours. Only five of 23 fish survived in one shipment and only one of six survived in a second. A third was more successful. With a total of eleven hours in transit, including only a single five-hour layover in Newark, New Jersey, all of the fish survived the trip.[45]

Encouraged by these results, Lindaman and his staff tried again during the 1952 collection season. Because of transport delays and other factors, however, some of the shipments saw a catastrophic loss of all specimens. It looked as if the uncertainty of layover scheduling was rendering the shipment of tropical fish by air impossible.[46]

Just when Lindaman was about to abandon further attempts at air shipment, National Airlines began operating non-stop between Miami and Philadelphia. "After considerable bickering," the airline agreed to transport the Aquarium's fish.[47]

Nine shipments were made between 17 August and 12 December of 1953. Although one failed completely when the aerator malfunctioned, killing all of the specimens, the remaining eight delivered 226 specimens of 36 species with a 92 percent survival rate.[48] A breakthrough

[43] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 44f.
[44] Fairmount Park Commission, *1950 Annual Report* (Jan 1951), 42.
[45] Fairmount Park Commission, *1951 Annual Report* (Jan 1952), 29.
[46] Fairmount Park Commission, *1952 Annual Report* (Jan 1953), 37.
[47] Fairmount Park Commission, *1953 Annual Report* (Jan 1953), 36.
[48] Fairmount Park Commission, *1953 Annual Report* (Jan 1953), 36.

had been achieved. Similar results were obtained virtually every year thereafter until the Aquarium was closed.[49]

None of this came cheap, however, and despite the success of air shipment, Aquarium staff still had a hard time keeping the fish alive. Although by 1953 the majority of the marine specimens were again tropical,[50] the Aquarium continued to experience a high in-house mortality rate. Specimens died from causes typical of any aquarium—old age, injuries received while fighting, or simply jumping out of the tanks.[51]

As the Aquarium was forced to devote more of its budget and manpower to acquiring sea water and marine fish than ever before, the lack of compensatory funding resulted in a deferral of maintenance to the buildings, infrastructure, and public exhibit areas. This caught up with the facility in a spectacular way in late 1949. On Sunday 18 Sep, Mr. and Mrs. Thomas Arnott, Jr., of 1823 73rd Avenue in Philadelphia, were visiting with their ten-year-old son Thomas. As the couple entered one of the exhibit rooms,[52] large chunks of plaster fell from above. The debris narrowly missed the boy, but the mother received cuts to her head and the father was knocked unconscious.[53]

After an evaluation of the Aquarium's physical condition revealed an alarming state of disrepair—including other precarious plaster work—the Fairmount Park Commission's Chief Engineer ordered the entire facility closed to the public so that long-delayed maintenance could

[49] Fairmount Park Commission, *1954 Annual Report* (Jan 1955), 34; Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 26; Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 36; Fairmount Park Commission, *1957 Annual Report* (Jan 1958), 32; Fairmount Park Commission, *1959 Annual Report* (Jan 1960), 38. No narrative regarding the Aquarium was included in the annual reports of the Fairmount Park Commission for the years 1958 and 1960 through 1962.
[50] Fairmount Park Commission, *1953 Annual Report* (Jan 1953), 35.
[51] Fairmount Park Commission, *1953 Annual Report* (Jan 1953), 37.
[52] The precise location of the incident is unclear. Conflicting reports mention both the Engine House and the marine exhibit in the New Mill House. It seems worth noting, however, that when the Aquarium reopened, the Engine House remained closed.
[53] "Aquarium is Closed After Injuring Two," *Philadelphia Inquirer* (21 Sep 1949), 35.

be accomplished throughout the complex of buildings.[54] It was expected to reopen by the end of October,[55] but the necessary repairs were so extensive that it wasn't until the first of December that the public was allowed back in.[56] Even so, the work was mostly cosmetic; although Superintendent Lindaman admitted that a thorough overhaul was needed, there was no money in the budget for that.[57]

The Superintendent tried to put the best face on a bad situation when he recorded in the Fairmount Park Commission's annual report for that year:

> The extensive program of improvement in the appearance of the Aquarium, inaugurated at the beginning, and carried on during the entire year, was outstanding among its many and varied activities. The Aquarium was closed to visitors from September 20th to December 1st so that some of this work could be completed more rapidly and without the possible danger of injury to any spectator or the exhibits.[58]

This was clearly disingenuous on Lindaman's part; no mention was made of the real reason "some of this work" was necessary in the first place.

Whatever repairs may have made, the Engine House remained closed to the public when the Aquarium was reopened. All of the specimens there were moved to other exhibits areas in the New Mill House and Old Mill House.[59]

Despite the catch-up maintenance, the Aquarium was still in poor shape. In 1952 Charles I. Thompson, the President of the Fairmount Park Commission, lamented that it was "in a

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[54] "Aquarium is Closed After Injuring Two," *Philadelphia Inquirer* (21 Sep 1949), 35.
[55] "City Gets Real Sea Water for Poor Fish at Aquarium," *Philadelphia Inquirer* (29 Sep 1949), 23.
[56] "Aquarium is Partly Reopened After Ten-Weeks Shutdown," *Evening Bulletin* (1 Dec 1949); "Repaired Aquarium Will Reopen Today," *Philadelphia Inquirer* (1 Dec 1949), 25; "Aquarium Outlives Indifference," *The Philadelphia* (12 Oct 1956).
[57] "Aquarium is Closed After Injuring Two," *Philadelphia Inquirer* (21 Sep 1949), 35.
[58] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 42.
[59] "Aquarium is Partly Reopened After Ten-Weeks Shutdown," *Evening Bulletin* (1 Dec 1949); "Aquarium Outlives Indifference," *The Inquirer* (12 Oct 1956). The Engine House was never reopened to the public during the remaining years of the Aquarium's operating tenure.

deplorable physical condition."[60] Chronic underfunding by City Council was blamed. Money went begging for even a fresh coat of paint on the walls.[61] Visitors were greeted with cracked windows, rusty tank fronts, and dirty exhibit signage. To reduce the cost of operating and maintaining the Aquarium, the entire marine exhibit in the New Mill House was temporarily closed off.[62] For the first time, the Fairmount Park Commission began to seriously consider shutting it down.[63]

The same year, the City of Philadelphia began operating under another new charter.[64] Authorized by the Pennsylvania state legislature and drafted by a special commission appointed by the mayor and City Council, the Philadelphia Home Rule Charter was approved by Philadelphia voters in a referendum in April 1951 and became effective on 7 Jan 1952.[65]

Since its establishment by the Pennsylvania state legislature in 1867, the Fairmount Park Commission had been a nearly autonomous agency. Organizationally separate from the City of Philadelphia, its commissioners were appointed by the Court of Common Pleas. The president of the commission—in effect, the chief administrative officer—was elected and appointed by the commissioners. While the Commission was entirely dependent upon the City of Philadelphia for its funding, it had broad powers to act within its domain, the Fairmount Park System.[66] It operated with little true accountability.

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[60] Fairmount Park Commission, *1951 Annual Report* (Jan 1952), 15.
[61] Fairmount Park Commission, *1951 Annual Report* (Jan 1952), 16.
[62] Fairmount Park Commission, *1952 Annual Report* (Jan 1953), 36; Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 35.
[63] Henry L. Davis, "Deteriorating Plant May Force City to Shut Down Aquarium," *Evening Bulleting* (1 Oct 1950).
[64] *Philadelphia Home Rule Charter* (American Legal Publishing Corporation, 20 Jan 2022), <https://codelibrary.amlegal.com/codes/philadelphia/latest/philadelphia_pa/0-0-0-262986>, accessed 12 Feb 2022.
[65] "City Charter Commission," *City of Philadelphia* (8 Nov 2000), <www.phila.gov/phils/docs/inventor/graphics/agencies/a142.htm>, accessed 10 Feb 2022.
[66] It had complete control over all hiring decisions, for example. A dust-up between the Fairmount Park Commission and the Philadelphia Civil Service Commission over control over hiring at the Aquarium in 1912 confirmed this. See "Ask Civil Service for Park Guards," *Philadelphia Inquirer* (20 Jul 1912), 2; "Ryan Upholds Park Commission," *Philadelphia Inquirer* (26 Jul 1912), 14.

Under the new Home Rule Charter, the Fairmount Park Commission was made a City agency and placed under the jurisdiction of the Philadelphia Department of Recreation while still maintaining its own identity.[67] The change was intended to make the operation of the Commission less opaque. It is arguable whether or not that goal was accomplished, but at least two unintended consequences were the result—it was now more difficult for the Fairmount Park Commission to compete with other City agencies for funding and it was no longer in full control over its own spending.[68]

If the increasing difficulties and costs of maintaining the marine exhibits were not enough, the freshwater population had begun to experience problems as well. The quality of the water, in fact, had an uneven history going back to the beginning.

Recall that when the Aquarium opened in 1911, raw water from the Schuylkill River was used but it was so polluted that it affected the appearance of the exhibits and the next year the Aquarium switched to municipal water—City tap water. In 1914, however, the Bureau of Water began to add chlorine the city's water. Chlorinated water is bad for fish, as anyone who has maintained a home fish tank can tell you, so the Aquarium searched for alternatives.

An artesian well had drilled on the grounds in 1925, but an anemic flow rate and high iron content meant that municipal water would always be needed to some degree. Because of this, freshwater contributions were gladly accepted. Over two years, for example, in 1937 and 1938, renowned Philadelphia brewing company C. Schmidt & Sons donated a combined 19,000

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[67] "Fairmount Park Commission," *City of Philadelphia* (8 Nov 2000), <www.phila.gov/phils/docs/inventor/graphics/agencies/a149.htm>, accessed 10 Feb 2022. Prior to 1952 the members of the Commission consisted of ten unpaid citizens appointed by the Board of Judges of the Court of Common Pleas and (ex-officio) the Mayor, Presidents of the Select and Common Councils, and two City engineers. The Home Rule Charter reduced City Council to a single chamber; the makeup of the Commission was changed to ten unpaid citizens appointed by the Court and (ex-officio) the Mayor, President of City Council, Public Property Commissioner, Recreation Commissioner, Water Commissioner, and Chief Engineer and Surveyor of the Department of Streets.

[68] "Park Group Hits Charter Change," *Philadelphia Inquirer* (29 Oct 1950), 55.

gallons of their own artesian well water.[69]

As municipal water continued to be used, it continued to cause problems. Superintendent Van Deusen had commented in 1941 that the freshwater fish are drugged by the city water "as people are by coal gas."[70] Throughout 1948 and 1949, the water was so cloudy that at times the fish could barely be seen in their tanks. Attempts to clarify the water were unsuccessful.[71] An old antagonist, chlorine build-up, also returned, killing all of the Aquarium's freshwater fish in February of 1949. To eliminate the chlorine, various filters were tried until an effective type was identified,[72] but the damage had been done.

When the chlorine problem looked like it had finally been solved, Superintendent Lindaman decided it was time to re-introduce trout as an exhibit.[73] Thirty-four fish—including brook trout, brown trout, rainbow trout, and albino trout—were supplied by the state hatchery in Huntdale, but all died within three days of arrival. A second collection of trout form the Bellefonte hatchery all died overnight. Lindaman concluded that the Aquarium's supply of fresh water simply could not support trout life.[74]

A new problem developed in 1951. A higher than usual mortality among the freshwater

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[69] Fairmount Park Commission, *Chief Engineer's 1937 Annual Report* (12 Jan 1938), 15; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 71.
[70] "Fish Drugged by City Water." *Philadelphia Inquirer* (10 Oct 1941), 2.
[71] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 43; Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 42.
[72] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 42; Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 37. The effective filter was produced by the Roberts Filter Manufacturing Company. Established in Philadelphia in 1889, the company is today known as the Roberts Filter Group and is headquartered in nearby Media, Pennsylvania. See Jerry R. Rogers, ed., "Environmental and Water Resources: Milestones in Engineering History," *ASCE Library, American Society of Civil Engineers,* (11 Jun 2012), <https://ascelibrary.org/doi/book/10.1061/9780784409282>, accessed 13 Dec 2021; *Roberts Filter Group* (2021), <www.robertsfilter.com>, accessed 13 Dec 2012.
[73] Recall that when the Aquarium first opened in 1911 a hatchery which demonstrated the process of raising trout, shad, and other fish was created in the Caretaker's House, one of the buildings on the deck of the Old Mill House. It had been shut down sometime after 1933. See Fairmount Park Commission, *Chief Engineer's 1933 Annual Report* (9 Jan 1934), 3.
[74] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 44.

fish began to be observed. The cause was quickly determined to be poisoning due to a chemical treatment—commonly called “blue stoning”—of the water in the East Park Reservoir, the source of the Aquarium’s municipal water supply. Blue stoning is an application of copper sulfate to control the growth of algae, fungi, and invasive aquatic plants. The Bureau of Water had implemented the treatment without notifying the Aquarium ahead of time.[75]

Inexplicably, and despite pleas from the Aquarium staff, the Bureau of Water again applied blue stoning treatments to the water in the East Park Reservoir without prior notice to the Aquarium the following year—not just once, but twice. The first time, during the first four days of April, all freshwater fish were again killed, 734 specimens of 19 species in all. After a lot of time and trouble was spent replacing the fish, another 353 specimens of 16 species were killed over two days in late September.[76] Aquarium staff must have raised quite a commotion with the Bureau of Water over the affair, because the problem never presented itself again.[77]

If the Aquarium was vexed by outside issues, sometimes the problems were of its own making. It had a hard time maintaining the supply of fresh water at a consistent temperature, for example. During winter months, the temperature would routinely fall below a healthy range.[78] At times, however, the water would overheat instead. This occurred repeatedly in 1955; during the course of the year, all of the freshwater fish were killed four times over.[79]

In 1957 Superintendent Lindaman summed up the Aquarium’s experience with its

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[75] Fairmount Park Commission, *1951 Annual Report* (Jan 1952), 29. Copper sulfate pentahydrate, $CuSO_4(H_2O)_5$, is the most common form of blue stoning. Highly water-soluble, it is still used today. The copper ions that are produced, however, are highly toxic to fish. See “Copper Sulfate,” *National Pesticide Information Center* (Dec 2012), <http://npic.orst.edu/factsheets/archive/cuso4tech.html>, accessed 13 Dec 2021; “Copper Sulfate Pentahydrate,” *National Library of Medicine, National Center for Biotechnology Information* (National Institutes of Health, U.S. Department of Health and Human Services, 2021), <https://pubchem.ncbi.nlm.nih.gov/compound/copper-sulfate-pentahydrate>, accessed 13 Dec 2021.

[76] Fairmount Park Commission, *1952 Annual Report* (Jan 1953), 37.

[77] Fairmount Park Commission, *1954 Annual Report* (Jan 1955), 35.

[78] Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 37.

[79] Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 25.

freshwater supply when he drily observed that the mortality rate "is always high, due to the inability of newly captured fish to adapt themselves to captivity in the treated city tap water."[80] The remark surely belied many years of frustration.

Because of multiple and repeated die-offs, Aquarium staff were in a constant race to find replacement specimens. Throughout its history, the stock of freshwater fish came mostly from waterways, ponds, and lakes in Pennsylvania,[81] especially the Schuylkill River.[82] Collection expeditions were occasionally made by Aquarium staff to the Great Lakes region.[83] Most years found private individuals donating interesting specimens as well.[84] By the 1950s, though, nearly all of the wild freshwater fish in the exhibits were harvested from the tidal portion of the Schuylkill River directly in front of the Fairmount Water Works using dip nets.[85] The collection was supplemented by fish from various Pennsylvania state hatcheries, including those at Bellefonte, Huntdale, and Pleasant Mount.[86] The most significant contributions at this time came, perhaps not surprisingly, from the Torresdale Hatchery in northeast Philadelphia.[87] In addition to the Schuylkill River and the state hatcheries, fish were obtained from time to time from such unlikely sources as the ponds at Fairmount Park's Horticultural Hall, the East Park and Lehigh

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[80] Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 37.
[81] See for example Meehan to Kane (8 Feb 1912); Fairmount Park Commission, *Chief Engineer's 1929 Annual Report* (8 Jan 1930), 3; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 73.
[82] Fairmount Park Commission, *Chief Engineer's 1935 Annual Report* (7 Jan 1936), 18.
[83] *Fairmount Park Aquarium* (1929), 4 (photograph), 5 (photograph), 6ff.
[84] See for example Fairmount Park Commission, *Chief Engineer's 1932 Annual Report* (11 Jan 1933), 4; Fairmount Park Commission, *1938 Annual Report* (Jan 1939), 70, 72; Fairmount Park Commission, *1942 Annual Report* (Jan 1943), 40; Fairmount Park Commission, *1947 Annual Report* (Jan 1948), 40. Specimens acquired in this way also included reptiles such as alligators and water snakes.
[85] See Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 36; Fairmount Park Commission, *1954 Annual Report* (Jan 1955), 34; Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 36; Fairmount Park Commission, *1959 Annual Report* (Jan 1960), 38.
[86] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43.
[87] Fairmount Park Commission, *1948 Annual Report* (Jan 1949), 43; Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 36; Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43; Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 36; Fairmount Park Commission, *1954 Annual Report* (Jan 1955), 34; Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 26. Specimens contributed by the Torresdale Hatchery included channel catfish and eels. In addition, the Pennsylvania Fish Commission donated two 21-inch alligators and a seven-foot alligator in 1956. See Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 36.

Avenue Reservoirs, and the sedimentation basin at the Torresdale Filtration Plant on the Delaware River.[88]

Some of the Aquarium's problems were caused by human error close to home. In 1956 new heating equipment was installed within the existing heating plant area which had been created in the northeast corner of the Old Mill House in 1914.[89] This was intended to serve both the Aquarium and Museum of Art and replace the old powerhouse on the eastern bank of the Schuylkill River just below Callowhill Street which had been filling that role since 1927. Noxious fumes generated during the installation of the new boilers killed most of the marine fish.[90]

The year before, likely in anticipation of the imminent decommissioning and demolition of the old power plant which had served the Aquarium and Museum of Art, a strange discovery came to light which may have had a connection to the development of Fairmount's South Garden over a hundred years earlier.

Recall that prior to 1854 the northern boundary of the City of Philadelphia was Vine Street, north of which was the municipality of Spring Garden. The Fairmount Water Works and Fairmount Reservoir were situated in Spring Garden but the property had been purchased by the City of Philadelphia. At the south end of the South Garden, the City-owned property stopped just short of the north side of Callowhill Street, near the eastern end of the Wire Bridge, where there was a popular entrance to the Fairmount grounds. In 1847, to alleviate a traffic congestion problem there, the City of Philadelphia and the municipality of Spring Garden swapped a small

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[88] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43. The Torresdale Filtration Plant is today called the Baxter Water Treatment Plant.
[89] Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 13f. The old heating plant was demolished the following year. It had been located on the Schuylkill River just below the Callowhill Street Bridge and had until 1926 been part of the Pennsylvania Door and Sash Company's factory complex.
[90] Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 35, 37.

bit of land. The City of Philadelphia gained a parcel of land on the north side of Callowhill Street which allowed it to extend the South Garden to Callowhill Street (and the Wire Bridge) and Spring Garden gained a small plot of land which the City of Philadelphia had happened to own on the south side of Callowhill Street.

While performing a routine check on properties for which the City made annual payments, employees in the office of the Commissioner of Public Property found that the City of Philadelphia had been paying $1,900 per year[91] in rent on a portion of the land on the south side of Callowhill Street near 26th Street. This is where the powerhouse was located. Available records did not go back more than 50 years, but the City had been making the annual payments for at least that long when it could have purchased the plot outright for $32,000,[92] although it is unclear at what point that was the value of the land.

The Commissioner of Public Property—who was also a member of the Fairmount Park Commission—urged his fellow commissioners to purchase the parcel with funds for the Fairmount Park system, but the other commissioners argued that it was the City's direct responsibility since a City agency had been appropriating funds for the rent payments all along.[93]

Certain problems were beyond the Aquarium's control. Some of its greatest challenges were simply by virtue of its location. Low to the water next to the Schuylkill River, it was vulnerable to flooding. Being housed in an historic building complex on an historic property created operational issues. The age of the buildings caused constant maintenance headaches. Tidal action on the discharge from the sewer completed in 1931 resulted in foul odors.

It was recognized as early as 1944 that the Aquarium would need to move to a more

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[91] In 1955 the amount was the equivalent of approximately $21,000 in 2022.
[92] In 1955 the amount was the equivalent of approximately $354,000 in 2022.
[93] "City Pays $1900 Rent for Small Park Plot," *Philadelphia Inquirer* (13 May 1955), 4. Available accounts do not specify the owner of the land to whom the rent was being paid. It is not known how or when the issue was resolved.

appropriate facility, designed from the ground up with the operational needs of a public aquarium in mind. Fairmount Park officials suggested such a facility would need to be considered after the eventual end of the war and estimated it would cost approximately $110,000.[94] Sites under consideration included the location of Plaisted Hall,[95] and a location in Fairmount Park above Girard Avenue.[96]

As if to reinforce the vulnerability of the location, heavy rains caused a flash flood in June 1946.[97] On Sunday 2 June, the Schuylkill River crested at 14.57 feet above Fairmount Dam.[98] The Aquarium was closed to visitors at three o'clock in the afternoon and floodwaters eventually rose to 26 inches above the main display floor in the Old Mill House and New Mill House.

There was a weather warning ahead of the flooding and Aquarium staff took advantage of the advance report. To head off damage, they removed centrifugal pumps, motors, and other equipment. To prevent contamination of the sea water, they moved as much of it as possible out of circulation and into storage tanks. Afterward, staff members worked staggered double shifts to clean up enough of the muck and mess to reopen the Aquarium to the public by noon the next day. By midnight, they had everything fully operational again. No specimens were lost.[99]

Aquarium staff were called upon again in 1950 to work hard to minimize the effects of flooding and recover as quickly as possible. Ahead of projected flooding in November, staff applied lessons learned in 1946 and again removed equipment and sea water, this time also

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[94] The equivalent of approximately $1.9 million in 2022.

[95] Plaisted Hall was a municipal recreation center located just to the north of the Fairmount Water Works, at the southern end of Boathouse Row. It was demolished in 1994 and replaced by Lloyd Hall in 1998.

[96] Frederic V. Lewis, "Silt Tunes River Into an Eyesore," *Philadelphia Inquirer* (7 Nov 1944), 19.

[97] "2 Drown as Schuylkill Flood Sweeps Huge Area Here; Road, Rail Traffic Disrupted," *Philadelphia Inquirer* (3 Jun 1946), 1, 2.

[98] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1.

[99] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 34.

relying for aeration on a backup air compressor and then a portable air compressor supplied by the Philadelphia Electric Company. The Schuylkill River eventually crested at 14.32 feet above Fairmount Dam.[100] This time, water rose to 29 inches above the main floor. Despite operating under emergency conditions for over four days, however, no specimens were lost.[101]

It was a different matter five years later. In August 1955, two hurricanes—first Connie, then Diane—passed through the region within days of each other. With the ground saturated by Connie, Diane dumped up to 20 inches of rain across the region and caused widespread damage.[102] The Schuylkill rose to 11.25 inches above Fairmount Dam on the 13th, fell a bit, then crested at 14.32 inches six days later.[103] Water rose to 39 inches above the main floor of the Aquarium. The prolonged flooding caused the death of a large percentage of the freshwater fish.[104]

While extreme weather events posed an existential threat to the Aquarium, other forces threatened historical elements of the Fairmount Water Works itself. In the 1950s a drama played out that had direct consequences for a key original component of the Fairmount Water Works. Recall that the Fairmount Dam, completed in 1822, was in fact a system composed of the dam itself, the Pier, Mound Dam, New Mill House, and Old Mill House on the dam's eastern end, and the system of canal locks on the dam's western end. By the time the drama was finished, a

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[100] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1.
[101] Fairmount Park Commission, *1950 Annual Report* (Jan 1951), 43.
[102] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1; "Connie Blows Out in Central Penna.; Floods Block Phila. Area Traffic," *Philadelphia Inquirer* (14 Aug 1955), 1, 2; "'Sister Act' Steals the Headlines Again: Connie and Diane Play Havoc Here And on Seaboard," *Philadelphia Inquirer* (22 Aug 1955), 3.
[103] National Weather Service, *Historical Floods: Schuylkill River at Philadelphia, PA (*National Oceanic and Atmospheric Administration, 21 Jan 2020), 1.
[104] Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 26. Two large sand sharks were also casualties. Working around the clock in staggered shifts, Aquarium personnel cleared the facility of mud and debris and reopened the Aquarium by ten o'clock in the morning of Saturday 20 Aug.

modern highway called the Schuylkill Expressway would be built along the west bank of the Schuylkill River opposite Fairmount, destroying the Fairmount locks in the process.

Since the time it was constructed, the Schuylkill Expressway has been an important component of the roadway system of the greater Philadelphia area. As early as 1926 it was realized that projected increases in population and mobility would need to be accommodated by an improved system of roads.[105] The first proposal for a roadway through the Schuylkill River valley, in 1932, was for a cars-only parkway; it would have been a relatively minor facility within a network of more substantial highways.[106] Post-World War II planning, responsive to growing urban traffic congestion, as well as to the changes in traffic patterns anticipated to be caused by the imminent extension of the Pennsylvania Turnpike through the region, transformed the highway into a linchpin of the regional system, the primary route from the Turnpike and points west into the heart of Philadelphia.[107]

The expressway was constructed in stages between 1949 and 1959, from an interchange with the Pennsylvania Turnpike at Valley Forge, south along the west side of the Schuylkill River valley, past center city, to south Philadelphia and a connection with Interstate 95 and the Walt Whitman Bridge to New Jersey. It is a limited-access highway for its entire 23-mile length and consisted entirely of two lanes in each direction when first built.[108]

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[105] *A Picture of the Region* (Regional Planning Federation, Philadelphia Tri-State District, 1926), 17.

[106] *The Regional Plan of the Philadelphia Tri-State District* (Regional Planning Federation, Philadelphia Tri-State District, 1932), 177, 560f.

[107] City Planning Commission, *Preliminary Report for the Schuylkill Expressway* (Philadelphia: 14 Dec 1949), Pennsylvania State Archives; Edgar Williams, "$260,000,000 Traffic Solution," *Philadelphia Inquirer* (19 Feb 1950), 145.

[108] Since 1964 the Schuylkill Expressway has been designated Interstate 76 (or I-76), but it was designed and largely built prior to the passage of the Federal-Aid Highway Act of 1956 and the beginning of the interstate highway era. See Richard F. Weingroff, "Federal-Aid Highway Act of 1956: Creating the Interstate System," *Public Roads*, Vol. 60, No. 1 (Washington, D.C.: Federal Highway Administration, U.S. Department of Transportation, Summer 1996), <https://highways.dot.gov/public-roads/summer-1996/federal-aid-highway-act-1956-creating-interstate-system>, accessed 8 Mar 2022.

During its planning by the Pennsylvania Department of Highways,[109] portions of the route of the expressway were very controversial, due mainly to alignments that planners had selected through Fairmount Park. Many thought that park land should not be sacrificed to solve traffic woes; others believed it was a necessary trade-off.

When the preliminary plans for the Schuylkill Expressway were released to the public in early 1950, the Fairmount Park Commission gave its concurrence to the City Planning Commission for an alignment between the Zoo and the Schuylkill River and over the canal locks at the western end of the Fairmount Dam.[110] The members of the Commission later admitted, however, that they hadn't performed due diligence and had made only a "casual" review of the plans.[111] It wasn't until 1952 that the Commission took a more thorough look and realized "the effect the plan would have."[112] These negative effects included the permanent destruction of the Fairmount locks.[113] Charles I. Thompson, President of the Fairmount Park Commission, then began to publicly oppose the routing, stating it would "deface the beauty of Fairmount Park."[114]

In January of 1953, Fairmount Park Commission Vice President John B. (Jack) Kelly proposed an alternate alignment that would pass to the west of the Zoo between the Zoo and the

[109] The Pennsylvania Department of Highways was consolidated with other transportation-related agencies into the Pennsylvania Department of Transportation (PennDOT) in 1970. See "50 Years of Building Communities," *Pennsylvania Department of Transportation* (2022), <www.penndot.pa.gov/about-us/50years/pages/default.aspx>, accessed 8 Mar 2022.

[110] City Planning Commission, *Preliminary Report for the Schuylkill Expressway* (Philadelphia: 14 Dec 1949), 3, Pennsylvania State Archives.

[111] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), 3, Pennsylvania State Archives.

[112] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), 2, Pennsylvania State Archives. It is important to point out that the area in question is the area along the Schuylkill River between the Girard Avenue Bridge and the Spring Garden Street Bridge (also known as the Callowhill Street Bridge). Today people tend to concentrate their dismay over the sacrifice of the portion of Fairmount Park along the Schuylkill River between City Avenue and Girard Avenue, but the Fairmount Park Commission seems to have readily offered up that area of park land with little controversy at the time.

[113] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), 4 (para. 9.h.), Pennsylvania State Archives.

[114] "Use of Fairmount Park for Expressway Fought," *Philadelphia Inquirer* (22 Oct 1952), 35.

rail line of the Pennsylvania Railroad, instead of passing to the east of the Zoo along the river. This alternative was estimated to cost $3 million more than the original alignment,[115] would require the acquiring of some Zoo property,[116] and would still result in the elimination of the locks.[117] State Department of Highways Secretary Edward L. Schmidt rejected Kelly's proposal on the grounds that it could not be constructed without the curves being too tight and that it would actually be $5.4 million more costly.[118]

When the Director of the Zoo, William P. Cadwalader,[119] objected to both the state's original alignment and Kelly's alternate, Kelly proposed a second alternate alignment, this one passing to the west of the Pennsylvania Railroad and along Mantua Avenue on the eastern edge of the Mantua and Powelton neighborhoods. It would have featured a local-access interchange with Powelton Avenue at 32nd Street. Cadwalader preferred this most westerly alignment because it avoided the Zoo; Kelly was strongly in favor of it because it avoided the locks.[120]

A group of 50 people started a petition drive to convince the governor to reconsider alternate alignments of the expressway,[121] but the Department of Highways threatened to abandon the highway project south of City Avenue if the original alignment wasn't implemented.[122] Although Thompson, President of the Fairmount Park Commission, complained about the state's "take it or leave it" attitude, [123] by June the Commission had begun to accept

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[115] The equivalent of approximately $33.3 million in 2022.
[116] "Park Board Approves New Expressway Route," *Philadelphia Inquirer* (9 Jan 1953), 12.
[117] "Plan Offered City for Expressway," *Philadelphia Inquirer* (22 Jan 1953), 8.
[118] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), 3, Pennsylvania State Archives; "Parley to Study Schuylkill Route," *Philadelphia Inquirer* (19 Apr 1953), 41; "New Plan Urged for Expressway," *Philadelphia Inquirer* (15 May 1953), 15. The amount was the equivalent of approximately $59.9 million in 2022.
[119] Cadwalader's formal title was President of the Zoölogical Society of Philadelphia.
[120] "Mayor Favors Sharing Park Expressway Cost to Win Alternate Route," *Philadelphia Inquirer* (24 May 1953), 1, 2, esp. map diagram at 2.
[121] "Fine to Receive 'Save Park' Plea," *Philadelphia Inquirer* (11 Jun 1953), 1.
[122] "Park Board Yields to State on Route of Expressway," *Philadelphia Inquirer* (4 Jun 1953), 1.
[123] "Park Board Yields to State on Route of Expressway," *Philadelphia Inquirer* (4 Jun 1953), 1; "Fine Raps 'Politics' in Road Feud," *Philadelphia Inquirer* (5 Jun 1953), 20.

that the expressway was not going to be routed along the far-western alignment Kelly had proposed, probably due to the cost and difficulty of plowing through an established neighborhood, not to mention the likely public resistance that would result. Since any alignment east of the Pennsylvania Railroad would result in the destruction of the Fairmount locks, this meant that they would certainly be lost.[124]

Retired Pennsylvania Supreme Court Justice Grover C. Ladner, however, publicly suggested a civil lawsuit might be in order. Citing the state legislation which created the Fairmount Park Commission in 1876, Ladner maintained that the Commission was prevented by law from ceding park land for a highway.[125] The threat of litigation nudged the governor into reversing himself and ordering a full evaluation of alternate alignments. Within two weeks he asked Michael Baker, Jr., whose civil engineering and construction firm was located near Pittsburgh, to work with Herschel Allen of the Greiner Company, the Fairmount Park Commission's engineering contractor, to investigate the issue and make recommendations on "the best route."[126]

The Baker commission did not consider Jack Kelly's proposed westernmost alignment, the one to the west of the Pennsylvania Railroad which ran through the Mantua and Powelton Village neighborhoods. It only considered the two alignments to the east of the railroad—the original alignment to the east of the Zoo along the Schuylkill River and the one to the west of the

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[124] "Fine Raps 'Politics' in Road Feud," *Philadelphia Inquirer* (5 Jun 1953), 20; "State's Arbitrary Action on Expressway Route, *Philadelphia Inquirer* (5 Jun 1953), 34; "Expressway in Fairmount Park," *Philadelphia Inquirer* (22 Jun 1953), 3, esp. photograph at bottom right.

[125] "Ladner Suggests Suit to Block Expressway," *Philadelphia Inquirer* (23 Jun 1953), 25. As the justice put it, "The important point that has been so far overlooked is that neither the Park Commission nor the City of Philadelphia has any right to permit Fairmount Park to be used for anything other than legitimate park purposes. Section 1 of the Act of 1867, P.L. 547, 548, which creates Fairmount Park, reads that it should be 'laid out and maintained forever, as an open public place and park, for the health and enjoyment of people of the said city and the preservation of the purity of the water supply of the City of Philadelphia.'"

[126] "Fine to Resurvey Expressway for Fairmount Park," *Philadelphia Inquirer* (8 Jul 1953), 1.

Zoo between the Zoo and the railroad.[127]

The panel recommended a compromise alignment in September 1953.[128] It was similar in location to the original alignment between the Zoo and the Schuylkill River, but instead of sitting low along the river and passing under the Pennsylvania Railroad and Girard Avenue bridges, it would be elevated on a viaduct and pass over the bridges. The recommended structure would rise 200 feet above the river at its highest point.[129] The alignment would be farther away from the river's edge, would spare more parkland than the original route, and would not require any Zoo property. It also had the advantage of being only $2.9 million more than the original,[130] versus the $5.4 million additional[131] that the alignment between the Zoo and railroad would cost.[132]

All of the alignments, including the compromise, necessitated the displacement of West River Drive toward the Schuylkill River, resulting in its reconstruction over the Fairmount Locks.[133]

By early October, all concerned had approved the compromise alignment, including the governor, Department of Highways officials, City officials, and the Fairmount Park Commission.[134] Three weeks later, however, the Fairmount Park Commissions Art Commission announced that it had voted 4 to 3 to reject the compromise viaduct option. The panel claimed

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[127] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), "Relative Plan Locations" at 18, Pennsylvania State Archives.
[128] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), 13, Pennsylvania State Archives.
[129] "Expressway Viaduct to Spare Trees Near Zoo," *Philadelphia Inquirer* (25 Sep 1953), 1, 32, esp. diagram at 32.
[130] The equivalent of approximately $32.2 million in 2022.
[131] The equivalent of approximately $59.9 million in 2022.
[132] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), Appendix I, "Table of Comparisons," Pennsylvania State Archives.
[133] Michael Baker, Jr., *Report to the Governor: Location of Schuylkill Expressway* (2 Sep 1953), "Relative Plan Locations" at 18, Pennsylvania State Archives; "Expressway Viaduct to Spare Trees Near Zoo," *Philadelphia Inquirer* (25 Sep 1953), 1, 32, esp. diagram at 32; "A Better Plan for Expressway in Fairmount Park," *Philadelphia Inquirer* (26 Sep 1953), 6.
[134] "Elevated Expressway in Park Gets Approval," *Philadelphia Inquirer* (8 Oct 1953), 6.

that the new City Charter, implemented in 1952,[135] gave it veto power and that its decision was binding on all parties. Although the Fairmount Park Commission had argued that the original lower-level option would destroy thousands of trees and a large recreation area, Roy F. Larson, President of the Art Commission, countered that " the high-level scheme almost completely destroys the natural beauty of a long and important stretch of river frontage in the park. The low-level plan will not destroy any more trees than the high-level crossing, but in the former this loss can be replaced, whereas in the high-level scheme, it will be impossible to mask the structure with the planning of trees for great parts of its length." [136] Within days, the City Solicitor declared that his research had forced him to conclude that the Art Commission did indeed have the power it claimed.[137]

At the same time a suit was filed by three taxpayers in Common Pleas Court seeking to prevent the Fairmount Park Commission from transferring or granting any rights to park land for the highway.[138] The presiding judge issued a temporary restraining injunction against the Commission until the request could be decided at a scheduled hearing.[139]

Lawsuit or no, it was becoming apparent that the state was getting its way. The City capitulated. Encouraged by Mayor Clark, Governor Fine ordered the go-ahead for the original alignment.[140] City Planning Commissioner Chairman Edward Hopkins, Jr., had written to the mayor:

> It is now clear that no acceptable alternate route can be developed which from one standpoint or another, does not have more serious objectionable features than the low-level

[135] "City Charter Commission," City of Philadelphia (8 Nov 2000), <www.phila.gov/phils/docs/inventor/graphics/agencies/A142.htm>, accessed 10 Feb 2022.
[136] "Viaduct is Ruled Out By Art Board," *Philadelphia Inquirer* (14 Nov 1953), 1.
[137] "Viaduct Up to Art Board," *Philadelphia Inquirer* (19 Nov 1953), 27.
[138] "Taxpayers' Suit Urges Ban on Expressway," *Philadelphia Inquirer* (18 Nov 1953), 41.
[139] "Injunction Curbs Transfer of Park Land for Expressway," *Philadelphia Inquirer* (19 Nov 1953), 27.
[140] "Original Plan Ordered for Expressway," *Philadelphia Inquirer* (9 Dec 1953), 1, 24.

> route already approved by all parties. The Planning Commission therefore hopes you will see fit to urge the Highway Department to proceed as promptly as possible with completion of necessary engineering plans for the letting of bids and the start of physical construction. Completion of this work at the earliest possible date is essential…to relieve traffic congestion on existing business and residential streets.[141]

Despite a last-minute plea from community leaders—including Jack Kelly—to reconsider the far westerly alignment in order to save the locks and other features,[142] the decision was carved in stone and final engineering plans were developed. The Fairmount locks were officially doomed.

In April 1956, construction contractors began clearing the land, starting in the area of the Zoo and preceding southward.[143] By the end of May, the eight-room locktender's house had been torn down and the historic locks were being buried under tons of fill taken from an area on the west bank of the Schuylkill River between the Spring Garden Street Bridge and the Pennsylvania Railroad's 30th Street Station.[144] Prior to being buried, at least the short stretch of canal between the guard lock on the upper end and the outlet locks on the lower end was partially demolished.[145] By the middle of June, construction was well under way along the entire segment

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[141] "Original Plan Ordered for Expressway," *Philadelphia Inquirer* (9 Dec 1953), 1, 24.
[142] "Group Asks Use of Mantua Ave. as Expressway," *Philadelphia Inquirer* (23 Jan 1954), 9.
[143] "W. River Drive Trees Sacrificed to Progress," *Philadelphia Inquirer* (11 Apr 1956), 31; *Philadelphia Inquirer* (11 May 1954), photograph at 29. The term for the clearing is "brushing and grubbing." Brushing refers to the cutting and clearing of vegetation; grubbing refers to the pulling of the root structures and other remains of the vegetation from the ground.
[144] "Torn-Up Streets Mark Progress in City's Projects," *Philadelphia Inquirer* (27 May 1956), 39, 44, esp. 44; Frank Rosen, "Old Canal Locks Yield to Inroads of Expressway," *Philadelphia Inquirer* (10 Jun 1956), 44. The last lockkeeper, George R. Schuck, had lived in the locktender's house with his wife Beulah until his death in 1952, after which Beulah tended the locks while she lived a few blocks away in the Poweton neighborhood. Toward the end, almost all of the lock traffic consisted of pleasure craft. The last paying customer was a privately owned motor cruiser which passed through on its way to the Delaware Bay in 1950.
[145] The extent to which the entire lock complex was destroyed by the construction of the Schuylkill Expressway is unclear. At least one photograph clearly shows demolition of the walls of the canal section between the locks. See Image 2005.007.0106 (3 Jun 1956), Russell S. Salmon, Philadelphia Inquirer photographer, collection of the Philadelphia Water Department Historical Archives.

between Girard Avenue Bridge to the north and the Spring Garden Street Bridge to the South.[146] By the summer of 1957, West River Drive was nearly completed on its new alignment on fill atop the locks.[147]

One remnant of the lock system remains visible today. A portion of the outer, riverside, wall was used as a retaining wall for West River Drive and reused in the late 1970s for the outer wall of the Fairmount Fish Ladder. Consisting of large stone blocks, it can be seen from the vantage point of the Fairmount Water Works.

The construction of the Schuylkill Expressway in this area also necessitated the modification of the Spring Garden Street Bridge (originally called the Callowhill Street Bridge). Spanning the Schuylkill River at the immediate south end of the South Garden, the double-deck structure had replaced the earlier Wire Bridge in the same location in 1875.[148] The upper level carried Spring Garden Street; the lower level connected the southern end of West River Drive to the east side of the river. The Schuylkill Expressway was routed under the upper level of the western end of the bridge, at the level of the original lower-level roadway, and a partial interchange was constructed—a southbound offramp up to Spring Garden Street and a northbound onramp down from Spring Garden Street.

Bridge piers and foundations at the west end of the bridge were in the way, however. To allow the expressway to pass beneath the upper level of the bridge, a 229-foot-long section of the structure just west of the main span had to be replaced. To minimize disruption to such an

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146 Frank Rosen, "Unguarded Pits and Excavations Peril Children," *Philadelphia Inquirer* (17 Jun 1956), 41.

147 "Progress Report: Expressway Extension," *Philadelphia Inquirer* (2 Jul 1957), 3, esp. photograph D at bottom right. This editor could find no documentary evidence of the entire lock system being destroyed prior to being buried. The locks are most likely largely intact beneath the fill under West River Drive (today called Martin Luther King, Jr. Drive).

148 James Baughn, "Callowhill Street Bridge," *Bridgehunter* (2020), <http://bridgehunter.com/pa/philadelphia/callowhill-street/>, accessed 10 Nov 2020; "Callowhill Street Bridge," *Library of Congress* (2020) <loc.gov/item/pa0900/>, accessed 10 Nov 2020.

important link across the river, an innovative technique was employed. In May 1957, the framework of the new structure was fabricated on temporary supports just to the south of the old span. When it was completed, the old structure was demolished, and the new span was moved on wheels and rails into place. After it was secured in its final position atop permanent support piers, the concrete roadway deck and parapets (side walls) were then constructed. The demolition, movement, and completion took nine days, instead of the several months that would have been needed with the conventional method of sequential demolition and construction in place.[149]

Charles I. Thompson, the President of the Fairmount Park Commission who with Jack Kelly had fought to save the Fairmount locks, died of a heart attack at the age of 58 in early August 1958.[150] Less than four months later, the portion of the Schuylkill Expressway opposite the Fairmount Water Works opened to traffic two days before Thanksgiving, on Tuesday 25 Nov 1958. It was part of a larger segment stretching from just north of the Girard Avenue Bridge to the north to a new bridge connecting with Vine Street to the south.[151] If Philadelphians had thought about the Fairmount locks at all, most of them soon forgot they had ever existed.

By 1954 a rather large silt island had formed along the eastern shore of the Schuylkill River, between the Fairmount Dam and Boathouse Row.[152] Overgrown with scrubby trees and brush, the unsightly island blocked the scenic vista across the river from the north end of the grounds of Fairmount in the area of the *Fountain of the Sea Horses* as well as from Plaisted Hall,

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[149] "Floating Bridge to Close Spring Garden Span 10 Days," *Philadelphia Inquirer* (12 May 1957), 25, 27; *Philadelphia Inquirer* (19 May 1957), photograph at 49; "W. River Drive, Lower Level of Bridge to Open," *Philadelphia Inquirer* (25 May 1957), 15. In the end, the bridge was reopened a day earlier than anticipated.

[150] "Charles Thompson, Civic Leader, Dies," *Philadelphia Inquirer* (4 Aug 1958), 7.

[151] "River Expressway Opens with Jams and Hitches," *Philadelphia Inquirer* (26 Nov 1958), 1, 3, 15. The segment cost a total of $20.7 million. A ribbon-cutting ceremony was held in the middle of the new Vine Street Bridge with Mayor Richardson Dilworth, Pennsylvania Secretary of Highways Lewis M. Stevens, and Chamber of Commerce President Andrew B. Young.

[152] Frank Rosen, "Dredging Job in Schuylkill to Restore Beauty," *Philadelphia Inquirer* (20 Jun 1954), 37, 38.

the municipal boat house. It was not, however, created by natural forces alone.

Silt build-up behind dams is a well-known phenomenon. It had become an issue in the Fairmount Pool behind Fairmount Dam as early as 1860,[153] just 18 years after the dam was first built. By 1870 it was recognized as a recurring issue[154] and the nascent Fairmount Park Commission dredged the area for the first time.[155]

A mud bank formed in front of Boathouse Row and began to hinder rowing by 1920.[156] Within a few years over 14,000 cubic yards of mud was dredged from the area. In 1925 the material was placed in a large hole excavated above the western shore of the Schuylkill River behind the western end of the Fairmount Dam.[157] In 1926 the material was simply dumped in deeper water in the middle of the river.[158] The problem was significant enough that an additional dredge was constructed over two years and put to work beginning in 1929.[159]

The problem wasn't confined to the Boathouse Row area. In the 1930s, over 60,000 cubic yards was dredged along the rowing course and from around the intake of the Belmont Works. Approximately 58,000 cubic yards of material was removed from the Boathouse Row area. Some of the dredged material was deposited in the bed of the abandoned inclined plane stretching up to the Belmont Plateau from the western end of the Columbia Railroad Bridge. Much of it was piled along the western shore of the river north of the Columbia Railroad Bridge.

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[153] Water Department, *Chief Engineer's 1860 Annual Report,* (21 Feb 1861), 13ff; Water Department, *Chief Engineer's 1861 Annual Report,* (16 Jan 1862), 5ff.
[154] Water Department, *Chief Engineer's 1860 Annual Report* (21 Feb 1861), 13ff; Water Department, *Chief Engineer's 1861 Annual Report* (16 Jan 1862), 5ff; Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 12f; Bureau of Water, *Chief Engineer's 1895 Annual Report* (20 Jan 1896), 72f, 171.
[155] Fairmount Park Commission, *1870 Annual Report* (31 Dec 1870), 3; *Fairmount Park Commission 1878 Annual Report* (May 1878), 48f; Water Department, *Chief Engineer's 1870 Annual Report* (16 Feb 1871), 8.
[156] "Passage of Beach Bill is Demanded," *Philadelphia Inquirer* (27 Jul 1920), 2.
[157] Fairmount Park Commission, *Chief Engineer's 1925 Annual Report* (13 Jan 1926), 6.
[158] Fairmount Park Commission, *Chief Engineer's 1926 Annual Report* (12 Jan 1927), 6.
[159] "New Dredge at Work: Removing Mud Flats in Schuylkill in Front of Boathouse Row," *Philadelphia Inquirer* (11 May 1929), 4; "Eliminating the Mud Flats in the Schuylkill," *Philadelphia Inquirer* (14 May 1929), 10.

Some of it, however, was intentionally placed along the eastern shore of the river, between the Fairmount Dam and Boathouse Row.[160] What was a muddy shoal became an island.

In the 1940s over 300,000 cubic yards of silt were dredged from the Schuylkill River along the rowing course, around the Belmont intake, and in front of Boathouse Row. Most of the material was dumped farther upstream, in the back channel between Peter's Island and the west bank of the river,[161] and some was used as landfill in an area south of the Fairmount Parkway near 23rd Street,[162] but over 55,000 cubic yards were again deposited on the silt island.[163] The island was graded to six feet above the water line, it was widened out into the river on the downstream side, and the channel behind it was filled in.[164] A channel dug in 1946 between the island and the river wall in an attempt to facilitate the flow of water past Boathouse Row in the hope of keeping the docks area clear was filled in again in 1949.[165]

Until 1933, all dredging was done by the Fairmount Park Commission. The federal Works Progress Administration accomplished the work from 1933 until that agency was disbanded in 1943. From 1943 to 1946 the City's Department of Public Works did the dredging. City Councils gave the job back to the Fairmount Park Commission in 1946.[166] Of the three agencies that dredged the Schuylkill River up to this time, only the Fairmount Park Commission deposited material on the silt island. It did this at least three times—in 1930, 1947, and 1949—

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[160] Fairmount Park Commission, *Chief Engineer's 1930 Annual Report* (14 Jan 1931), 9; Fairmount Park Commission, *Chief Engineer's 1931 Annual Report* (13 Jan 1932), 9; Fairmount Park Commission, *Chief Engineer's 1933 Annual Report* (9 Jan 1934), 2; Fairmount Park Commission, *Chief Engineer's 1934 Annual Report* (9 Jan 1935), 34.
[161] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 19. "Peter's Island, long a landscaped feature of the park, was lost."
[162] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 19.
[163] Fairmount Park Commission, *1947 Annual Report* (Jan 1948), 22; Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 25.
[164] Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 26.
[165] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 20; Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 26.
[166] Fairmount Park Commission, *1946 Annual Report* (Jan 1947), 20.

placing a total of at least 125 cubic yard of material there. Although silt had always tended to accumulate in the area, the silt island is almost entirely a creation of the Fairmount Park Commission.

Clearance of river silt continued to be a problem into the 1950s. The Commonwealth of Pennsylvania had cleaned the Schuylkill River of coal silt down to Norristown by the start of the decade. The federal government had arranged to fund the cleaning from Norristown to Fairmount Dam by the end of the decade, but funding constraints caused by the ramp-up for the Korean War resulted in diversion of the funds and a delay in the work. During the delay the Fairmount Park Commission's Chief Engineer complained that the City of Philadelphia was forced to spend $200,000 a year[167] to fix a problem not of its own making.[168]

Beginning in 1954, contractors funded by the U.S. Army Corps of Engineers removed culm deposits (coal silt) between Falls Bridge and the Fairmount Dam. Nearly 4 million cubic yards of material were ultimately removed.[169] Because wholesale restoration of the Schuylkill River was the goal,[170] the Corps intended to eliminate the silt island. The Fairmount Park Commission opposed the idea, however, claiming it intended to landscape the feature and provide public access to it.[171] The silt island stayed, but it remained unimproved.[172]

The overgrown shoal wasn't the only thing to affect the view from the area of the

[167] The equivalent of approximately $2.3 million in 2022.
[168] Fairmount Park Commission, *1950 Annual Report* (Jan 1951), 7.
[169] Frank Rosen, "Dredging Job in Schuylkill to Restore Beauty," *Philadelphia Inquirer* (20 Jun 1954), 37, 38. A 12-mile-long floating pipeline transported the dredged material down the Schuylkill River to the Eastwick neighborhood in southwest Philadelphia where a planned community was to be built. The dredging cost $3 million.
[170] "120,000 Tons of Rock to Improve Schuylkill," *Philadelphia Inquirer* (17 Apr 1955), 41, 46. Previously deposited material was removed from the west bank of the river and rock excavated during construction of the Schuylkill Expressway was used as enormous rip-rap during restoration of the shoreline.
[171] Frank Rosen, "River Cleanup Stresses Beauty," *Philadelphia Inquirer* (20 Jun 1954), 37, 38; "Beautification of Schuylkill Banks Now in Sight," *Philadelphia Inquirer* (4 Jul 1954), 14. The work did include the restoration of Peter's Island.
[172] It is still there today and remains "unimproved."

Fountain of the Sea Horses. If the Schuylkill Expressway and Schuylkill River dredging were drama writ large, a slow-motion public argument developed in the late 1950s over a seemingly minor feature.[173] Since 1929 the Pennsylvania Department of Forests and Waters had maintained a river level gauge in a small building on the western shore of the Schuylkill River approximately 150 feet upstream of the Fairmount Dam and locks. While construction of the Schuylkill Expressway through the area was ongoing, however, access to the shoreline was difficult, so in late November of 1956 the Department of Forests and Waters, in cooperation with the U.S. Department of the Interior and with the approval of the Fairmount Park Commission, constructed a replacement on the eastern edge of the Schuylkill River, forty feet upstream of Fairmount Dam and directly in front of the fountain. The gauge was housed in a concrete building five feet wide, four feet deep, and twelve feet high.

Members of the Art Commission, whose approval was required before changes could be made to Fairmount Park property and structures, considered the little building quite the eyesore and indeed it was, as much for its location as for anything else. Assurances of the temporary nature of the facility were given during the gauge's relocation but after construction of the expressway in the area was completed, institutional inertia on the part of the state prevented a timely return of the gauge house to the original site. Despite regular and persistent protests by the Art Commission, the gauge wasn't moved back to the west shore until ten years later, in October 1966, when a cinder block building of similar dimensions, but only approximately seven feet tall,

[173] "Penna. To Retain Building on River," *Philadelphia Inquirer* (9 Jun 1957), 29; William A. Forsythe, "River Gauge Near Temple of Love Doesn't Touch Heart of Art Board," *Evening Bulleting* (25 Sep 1960); William A. Forsythe, "State Quits Measuring River In Row Over Gauge Tower," *Evening Bulleting* (3 Nov 1960), 32. The nearby Plaisted Hall, the municipal boat house at the southern end of Boathouse Row, was known colloquially as the Temple of Love.

was constructed there by the Philadelphia Water Department.[174]

Some developments to the grounds surrounding the Aquarium were of a more positive nature. Recall that in 1932, funding challenges had resulted in a halt to improvements in the landscaping and Fairmount and a lack of attention paid to the park grounds behind the Art Museum. The war years which followed were less than kind to the environs of the Aquarium as well.

In 1947, four larger-than-life statues of Revolutionary War generals were installed in the northwestern terrace between the Museum of Art and the *Fountain of the Sea Horses*. Collectively known as the William M. Reilly Memorial, after the Pennsylvania National Guard general who funded the installation in his 1890 will, the artwork commemorated four foreign volunteers who had participated in the cause of American liberty. Statues of Richard Montgomery, Casimir Pulaski, Friedrich von Steuben, and the Marquis de Lafayette faced each other in pairs across the double allée. In 1957 the statue of Captain John Paul Jones was added. The addition of a statue of General Nathaniel Greene completed the group in 1961.[175]

The Pennsylvania Horticultural Society in 1952 stepped in to do what it could to facilitate much-needed improvements. Working with the Fairmount Park Commission, it created the Azalea Garden in the four-acre, triangular area between the *Fountain of the Sea Horses*, the artificial hill behind the Art Museum, and East River Drive.[176] In the heart of the area that was

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[174] "USGS 01474500 Schuylkill River at Philadelphia, PA," *U.S. Geological Survey* (last modified 13:30:37 EDT, 21 Apr 2021), <https://waterdata.usgs.gov/usa/nmis/uv?01474500>, accessed 21 Apr 2021. The operation of the river level gauge is currently funded jointly by the Philadelphia Water Department, Philadelphia District of the U.S. Army Corps of Engineers, and U.S. Geological Survey.

[175] "William M. Reilly Memorial: Revolutionary War Heroes," *Association for Public Art* (2022), <www.associationforpublicart.org/artwork/william-m-reilly-memorial-revolutionary-war-heroes/>, accessed 2 Aug 2022, adapted from Penny Balkin Bach, *Public Art in Philadelphia* (Temple University Press: Philadelphia, 1992).

[176] Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 14f; "New Garden in Fairmount Park Area," *Philadelphia Inquirer* (24 Aug 1952), 58; "Break Ground Tuesday for Park Garden," *Philadelphia Inquirer* (19 Oct 1952), 61; "Mayor to Break Ground for Garden," *Philadelphia Inquirer* (20 Oct 1952), 36; "Park Azaleas say 'Welcome' to May Visitors," *Philadelphia Inquirer* (8 May 1960). East River Drive is today called Kelly Drive.

once called the Flat Iron, the garden featured a variety of azalea plantings that was designed to ensure there was something in bloom during all but the coldest months. Perennially popular throughout the years,[177] it is still today a favorite spot for photography, wedding parties, and simple relaxation for visitors to the area around the Fairmount Water Works.[178]

Two years later another nearby corner of Fairmount Park property was improved. South of Fairmount, on the east side of the Schuylkill River between the power house and the rail line of the Baltimore and Ohio Railroad, a dockside waste disposal facility had operated for decades. Trash was trucked there for staging before being loaded onto barges for dumping at sea. When the operation shut down in 1951, the Philadelphia Police Department began to use the area as a vehicle impoundment lot for wrecked, abandoned, and confiscated automobiles. By 1954 the high-visibility lot had grown into a junkyard with approximately a hundred vehicles, an eyesore in the shadow of the art museum.

When privately-voiced complaints went nowhere, the Fairmount Park Commission and Art Commission protested publicly. The U.S. Army Corps of Engineers, in the midst of a multi-million-dollar river restoration project, chimed in with its own finger-wagging. After pictures of the blight were published in the local press, the City Managing Director announced that the vehicles would be moved.

The City negotiated with the State of Pennsylvania for the use of land near the western end of the Penrose Avenue Bridge over the Schuylkill River near its confluence with the Delaware River.[179] Approximately 40 of the more saleable vehicles were auctioned off; the rest

[177] "Park Azaleas say 'Welcome' to Park Visitors," *Evening Bulleting* (8 May 1960); "Park Azalea Festival to Open Sunday," *Evening Bulletin* (1 May 1970).
[178] "Azalea Garden," *The Cultural Landscape Foundation* (2020), <https://tclf.org/landscapes/azalea-garden>, accessed 12 Jan 2021.
[179] Today called the George C. Platt Memorial Bridge.

were moved to the new impoundment area.[180] The Fairmount Park Commission planned to build a parking lot for visitors to both the Philadelphia Museum of Art and the planned new Aquarium facility, but instead merely landscaped the area as a grassy open space.[181]

If some of the changes to the area surrounding the Aquarium were positive and some less so, others never got off the ground at all.

In 1961 a local businessman proposed a cable car attraction that would cross the Schuylkill River. Supported by three 125-foot-high towers, the system would have run fifty four-passenger cars in an 8,000-foot loop between the Philadelphia Museum of Art, Fairmount Park Aquarium, and Philadelphia Zoo. Conceived by the nonprofit Philadelphia Marina Inc. as a way to draw visitors to the three attractions, the proposal was part of a proposed recreation center to be built near Fairmount. The center would have also included a restaurant, historical exhibit, fishing pond, and outdoor skating rink. The nonprofit would have fronted the construction cost, leased the property from the City, and turned it all over to the Fairmount Park Commission when the costs were recovered through admission and other fees.

Although favored by Mayor Dilworth, the Fairmount Park Commission's Art Commission nevertheless rejected the project out of hand. There was no place in which to shoehorn parking at the Fairmount end, said the board, and it would ruin the aesthetics of the Museum of Art, the Fairmount Works, and the surrounding park grounds. It never got further

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[180] The Philadelphia Police Department still operates a vehicle impoundment lot at this location near the Philadelphia International Airport today.

[181] Frank Rosen, "Auto Graveyard New Museum Hit as Eyesore," *Philadelphia Inquirer* (3 Oct 1954), 41, 44; "City to Rid Park of Auto 'Graveyard,'" *Philadelphia Inquirer* (10 Oct 1954), 41; "Getting Rid of the Wrecks," *Philadelphia Inquirer* (11 Oct 1954), 18. In 2013, Paine's Park skatepark was created at this site. See "Paine's Park," *Franklin's Paine* (2022), <franklinspaine.com/skateparks/paines-park>, accessed 9 Mar 2022; "Paine's Park," *Bittenbender Construction* (2022), <https://bittenbenderconstruction.com/project/paines-park>, accessed 9 Mar 2022; "Wow, Philadelphia Did Something Smart!" *Quarter Snacks* (22 May 2013), <https://quartersnacks.com/2013/05/first-look-paines-skatepark-in-philadelphia>, accessed 9 Mar 2022.

than the conceptual stage.[182]

The most outlandish proposal of all, however, was for a massive heliport and parking deck over the entire width of the Schuylkill River. Proposed by the Chamber of Commerce in 1956, the project would have stretched from the Spring Garden Street Bridge down to the Market Street Bridge—nearly three quarters of a mile—completely coving the river, the Schuylkill Expressway, a large part of the Pennsylvania Railroad yard on the north side of the 30th Street Station, and an open area south of the Aquarium between the river and the Parkway. The double-deck structure would have accommodated a helicopter airfield on top and 40,000 automobiles underneath.

Conceived as a way to facilitate the city's economic development, the venture would have nearly doubled the amount of total available parking in the center city area. It received tentative approval by a number of officials before saner heads prevailed and it was never built.[183]

Any location that remains popular enough, long enough, eventually becomes the setting for human drama. The same year the Azalea Garden was created, a 12-year-old boy riding a bicycle with a 9-year-old girl on the handlebars coasted down the steep Central Cliffside Path. Quickly picking up speed, they failed to negotiate the sharp switchback curve below the Stone Arch Bridge and crashed into the wrought iron fence at the edge. They were pitched over the fence and fell twelve feet to the walkway below; the boy suffered a fractured skull and the girl a

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182 "Art Group Bars Cable Car Plan Over Schuylkill," *Philadelphia Inquirer* (23 Mar 1961), 25; "Art Commission Can't Picture Cable Cars," *Philadelphia Daily News* (23 Mar 1961), 6. Reacting to the rejection, and angry Philip Klein, who led the nonprofit corporation, complained, "We might as well close up the city if we are going to bow constantly to the great god of the park." Klein soon proposed a marina and cable car system near the Philadelphia International Airport instead, but that project was never built either. See "Klein Sees New Route for Cable Cars," *Philadelphia Inquirer* (20 Feb 1962), 6.

183 Saul Schraga, "Heliport and Auto Deck Proposed," *Philadelphia Inquirer* (26 Apr 1956), 1, 4. Eleven years later, the mayor at the time suggested a smaller heliport facility on the portion of the east bank of the river that would've been covered by the earlier project, but the Fairmount Park Commission rejected that idea as well. See "Board to Study Heliport Near Art Museum," *Evening Bulleting* (9 Feb 1967).

broken left arm.[184]

Children exhibiting poor judgment is not surprising. When adults do, it tends to be more of a head-shaker. On a cool, overcast[185] mid-Thursday morning in May 1957 a 69-year-old man decided to clamber from the western shore of the Schuylkill River out onto the rocks below Fairmount Dam that are exposed at low tide. He later said he wanted to see the water falling over the dam from as close as possible. Mesmerized by the view, he didn't realize until it was too late that the rising tide had stranded him about fifty feet out into the river. While trying to make it back from whence he came, the swirling water began to carry him downstream. After a short distance he found a projecting rock to hang on to.

No one heard the man's shouts for help, but about a half hour later Aquarium Superintendent Lindaman noticed his frantic waving when he happened to look out a window. Lindaman telephoned the Park Guards at the Sedgley guard house. From there the Park Guards called the Philadelphia Police Department, whose Motor Harbor Patrol trucked over a boat and lowered it into the water. Two police officers on the boat plucked the exhausted man from the drink.[186]

The flow over the Fairmount Dam has had a rather placid appearance ever since the rounded concrete portion was completed in 1926, but it is more dangerous than it looks. When the fast-moving water coursing over the dam meets the slower water below it, a phenomenon called a hydraulic jump is created. The hydraulic jump creates an area of turbulent, backward-circulating water called a boil. A person falling over the dam is likely to be caught in the boil and

[184] "Couple on Cycle Injured in Crash," *Philadelphia Inquirer* (3 Sep 1952), 31.
[185] "May 16, 1957 Weather History at Philadelphia International Airport," *Weather Spark* (2022), <https://weatherspark.com/h/d/147134/1957/5/16/historical-weather-on-thursday-may-16-1957-at-philadelphia-international-airport-pennsylvania-united-states-#figures-cloudcover>, accessed 17 Mar 2022.
[186] "Man Clings to Rock, Rescued in Schuylkill," *Philadelphia Inquirer* (17 May 1957), 10.

held under the water. When the water level is high for some reason—heavy rainfall, say, or spring snow melt upstream—the hydraulic jump can become hidden but even more powerful.

In 1943 a 25-year-old Navy seaman and his date were enjoying a romantic Saturday morning on the river when their rented canoe was carried over the dam. They passed through the turbulence by clinging to the canoe and were rescued by Aquarium night attendant Leo McDermott and a Park Guard. McDermott and the Park Guard had just finished rescuing a dog from the river when they heard the couple's cries for help.[187]

A year later, three boaters were not as fortunate. On a Sunday afternoon in March, four friends—a 25-year-old and three teens—rented two canoes on the Schuylkill River above Fairmount Dam. The river was high and the current swift due to early spring rains. Two of the teens were in one canoe and allowed it to get too close to the dam. As the current threatened to wash them over the dam, they panicked and jumped into the river. The two in the other canoe tried to rescue their friends; one of the teens in the water managed to hold on to their friends' canoe, but the other was swept over the dam.

A man and his companion in a nearby third canoe heard the commotion and tried to help. Their good intentions were no match for the current, however, and their canoe was pulled over the dam. The man in the third canoe and the boy in the first were caught in the boil below the dam and were drowned.

The girl in the third canoe made it past the boil but continued to struggle as she was carried downstream past the Aquarium at the Fairmount Water Works. By now, hundreds of

[187] "Sailor, Girl Rescued in Schuylkill," *Philadelphia Inquirer* (26 Jun 1943), 13. McDermott would rise through positions of increasing responsibility at the Aquarium, becoming in 1960 its final Superintendent. See Robert J. Salgado, "Once-Thriving City Aquarium is Deserted," *Evening Bulleting* (19 Dec 1969); James Smart, "Leo's at the Helm Of an Aquarium Without Any Fish," *Sunday Bulletin* (10 Dec 1972), 7; "Leo McDermott [obituary]," *Philadelphia Inquirer* (14 Jun 1977), 24.

visitors to the Aquarium and surrounding Fairmount Park lined both shores as they watched the drama before them. Many tried to help the woman by throwing life preservers, tree limbs, and other buoyant objects into the water near her, but she was not able to reach any of them. As she was carried beneath the Callowhill Street Bridge, she disappeared under the water for the last time and drowned.

Of the six people involved in the incident, three perished—one of the teens and the couple who tried to help.[188]

Later in the decade there was a valiant rescue attempt by a Park Guard. At eleven o'clock in the morning of Saturday 17 Apr 1948, John V. Money was directing traffic on East River Drive near the Lincoln Monument Circle[189] when he heard a child call out to him, "A kid's drowning!" A six-year-old boy had been playing with his friends along the river wall on the east side of the river just above Fairmount Dam and had fallen into the water about a hundred feet upstream of the Eagle Pavilion. Money sprinted the 500 feet or so to where the boy had fallen. Seeing the child struggling in the water and being carried toward the dam, the 35-year-old Park Guard quickly threw off his service revolver and uniform coat and dove into the river. In the urgency of the moment, Money neglected to remove his uniform shoes, hat, and tie.

Money got to within a few feet of the boy but they were both swept over the dam before he could reach him. Hampered by his shoes and clothing and beginning to be choked by his tie, Money was violently tossed around in the boil below the dam. He was nevertheless able to reach the surface. He tore off his tie, plunged down into the 18-foot-deep water, somehow found the

[188] "3 Die in Schuylkill AS Canoes Go Over Fairmount Dam," *Philadelphia Inquirer* (27 Mar 1944), 1, 10.
[189] East River Drive was renamed Kelly Drive (after John B. Kelly, Jr., son of the Fairmount Park Commissioner and brother of actress Grace Kelly) in 1985. See Vernon Loeb, "The Latest Word on the River Drives," *Philadelphia Inquirer* (4 Mar 1988), 32. The Abraham Lincoln Monument was moved to one side and the circle reconfigured into an intersection with Sedgley Drive and Waterworks Drive in 2002. See David O'Reilly, "Honest, Abe Has Been Moved on Kelly Drive," *Philadelphia Inquirer* (5 Jan 2002), B01, B02.

boy, and pulled him to the surface. He then swam with the unconscious child in tow to the downstream side of the Mound Dam where a second Park Guard pulled them both out of the water.

Ambulance personnel were unable to revive the boy, however, and he was declared dead upon arrival at nearby Hahnemann University Hospital a short time later.

Money himself had nearly drowned as well. An athletic man and veteran of World War II with the 97th Infantry Division, he credited his stamina and strong swimming skills to his military training and combat experience. Even so, he was fortunate to have lived to return to his wife and three-year-old daughter. “Only a man like Money could survive,” remarked Fairmount Park Commissioner John B. Kelly. “There’s a terrible suction on the lower side of the dam. It shows the physical prowess of this Park Guard, and it also demonstrates the extent of his remarkable effort to save the boy’s life.”[190]

Money was recognized for his bravery. Ten days later he was awarded the Inquirer Hero Award in an afternoon ceremony at Park Guard headquarters in Fairmount Park’s Memorial Hall. The award’s gold medal and a check for $200[191] were presented by Superintendent of Park Guards Albert R. Conrath before an assemblage of Fairmount Park Commissioners, fellow Park Guards, and police and fire officials and personnel. That evening, portions of the ceremony were broadcast on the new television station WFIL-TV. Kelly called Money’s act a “most heroic deed.” Aquarium Superintendent Harry R. Lindaman marveled, “This is one of the most heroic acts that I have ever seen or heard of.”[192]

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[190] “Officials Praise Park Guard Hero,” *Philadelphia Inquirer* (11 May 1948), 25.
[191] The equivalent of approximately $2,460 in 2022.
[192] “Boy, 6, Drowns at Schuylkill Dam as Rescue Fails,” *Philadelphia Inquirer* (18 Apr 1948), 21, 28; “Park Guard Gets Award as Hero,” *Philadelphia Inquirer* (10 May 1948), 19; “Officials Praise Park Guard Hero,” *Philadelphia Inquirer* (11 May 1948), 25.

Money remained pensive. “I hope I never have to go through this again,” he reflected. “The worst of all was seeing that helpless kid die.”[193]

Twice during the period the Aquarium operated, people attempted suicide at Fairmount Dam. On a summer Sunday morning in 1938 a 24-year-old mother, possibly despondent over her recent divorce, successfully committed suicide by jumping into the boil area below the dam from the wall of the canal lock on the western end. Unfortunately, she carried her five-year-old daughter with her. The woman left her coat and her daughter’s shoes and pink dress atop the wall of the lock, along with a note that read, “I’m tired of living and I’m taking my little girl with me.” Both were drowned.[194]

During the evening of Saturday 16 May 1953, a 73-year-old man, depressed over losing his job, attempted suicide by jumping from the Aquarium deck into the river 35 feet below. A visitor strolling the grounds of the Aquarium saw the man leap and called to a Park Guard who shed his uniform coat and dove in after the man. The Park Guard held the man above water for twenty minutes until a Fire Department rescue squad arrived and pulled them both out onto the lower level of the Mound Dam. The man survived with a broken left leg.[195]

One tragic event was entirely avoidable. Two incidents six days apart in 1935 resulted in the death of a man on the grounds of the Aquarium. On Wednesday 4 December, an unidentified man broke into the Aquarium after hours and slashed a female worker on the back of the neck when she surprised him. Just after eleven o’clock on the following Tuesday, the same man tried to break in again but in the process was noticed by two Park Guards.[196] While attempting to

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[193] “Boy, 6, Drowns at Schuylkill Dam as Rescue Fails,” *Philadelphia Inquirer* (18 Apr 1948), 21, 28.
[194] “Note Hints Death Leap in Schuylkill By Divorcee, Child,” *Philadelphia Inquirer* (13 Jun 1938), 1, 6.
[195] “Guard Buoys Up Man 20 Min. in River Leap,” *Philadelphia Inquirer* (17 May 1953), 10.
[196] The Fairmount Park Commission maintained a separate police force, the Park Guard, with jurisdiction within the Fairmount Park system. See “Fairmount Park Guards Have a Strenuous Job,” *Philadelphia Record* (14 Aug 1910),

apprehend the man, the Park Guards shot and killed him as he tried to flee.[197]

Another drama certainly fell into the category of farce. In 1949 two police patrolmen were suspended and charged with neglect of duty after they were caught sleeping at the Aquarium. Toward the end of a night shift, at four-thirty on a Thursday morning in April, one was found sleeping in his patrol car while it was parked along Aquarium Drive and the other was found asleep in a chair in the Aquarium office, of all places. Because their sergeant had failed to control his officers' delinquent behavior, he was suspended as well. The suspensions were part of a larger crackdown on negligent police officers by the Police Department Superintendent and the Director of Public Safety.[198]

As the Aquarium's woes continued, the diminishing fish population on exhibit began to attract public criticism.[199] Unsubstantiated reports imminent closure circulated.[200] The visitor count trended decidedly downward. From a high of over a million in 1933, annual attendance trended downward, dropping to less than half that by the end of World War II[201] and dwindling to an average of just over 265,000 in the late 1950s.[202]

In an effort to stop the spiral of contraction, the Fairmount Park Commission in early 1953 created an intermediate organization—the Fairmount Park Aquarium Society—to run the

1ff, courtesy Special Collections Research Center, Temple University Libraries; "Park Guards on Parade," (28 Jun 1944), courtesy Special Collections Research Center, Temple University Libraries. The Park Guard was absorbed into the Philadelphia Police Department in 1972. See Don McDonough, "O'Neill Gets Control of Park Guards," Philadelphia Inquirer (10 Feb 1972); Paula Herbut, "Cella Quits as Head of Park Police, Blasts 'Merger' With City Force," Evening Bulletin (13 Apr 1972), courtesy Special Collections Research Center, Temple University Libraries.

197 "Prowler at Aquarium Slain by Park Guards," *Philadelphia Inquirer* (11 Dec 1935), 1.

198 "Sutton Suspends Ten Policemen; Six Found Asleep," *Philadelphia Inquirer* (22 Apr 1949), 1, 3.

199 Fairmount Park Commission, *1949 Annual Report* (Jan 1950), 43.

200 Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 35.

201 Fairmount Park Commission, *Annual Reports,* 1933–1946. Annual attendance in 1946 was 502,622.

202 Fairmount Park Commission, *1956 Annual Report* (Jan 1957), 25; Fairmount Park Commission, *1957 Annual Report* (Jan 1958), 14; Fairmount Park Commission, *1958 Annual Report* (Jan 1959), 14; Fairmount Park Commission, *1959 Annual Report* (Jan 1960), 14.

Aquarium.[203] Organized at the request of the Commission by retired Pennsylvania Supreme Court Justice and longtime conservationist[204] Grover C. Ladner,[205] the nonprofit corporation assumed the management and day-to-day operation of the facility for the Fairmount Park Commission.

The first thing the organization did was ask the Fairmount Park Commission for $10,000[206]—$4,000 for office space and $6,000 to conduct a professional survey to identify the needs of the Aquarium and the desires and expectations of its "customers." Mayor Clark thought that taking that much money from elsewhere in the Fairmount Park system budget had the potential to "cripple other park projects" and suggested the money be raised through private sources instead.[207]

The immediate goals of the group were the rehabilitation of the aquarium facility and the arrangement of a reliable supply of fish and other specimens. Funds were solicited from the public in the form of four types of membership—ordinary membership for $5.00 per year,[208] lifetime membership for a one-time contribution of $200,[209] Donor status for a one-time contribution of $1,000,[210] and Benefactor status for a one-time contribution of $5,000.[211]

About the same time, Charles Vanda, the Vice-President for Television at the local

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[203] Fairmount Park Commission, *1953 Annual Report* (Jan 1954), 15, 37; Joe Pancoast, "New Group Will take Over Aquarium From Park Board," *Evening Bulletin* (13 Mar 1953), 46; "Philadelphia Fish Story," *Philadelphia Inquirer* (11 Oct 1953), 190.
[204] See for example "Address by Grover C. Ladner, Esq., to Pennsylvania Division of Izaak Walton League of America, Mon 9 Sep 1929," *Philly H_2O* (30 Apr 2005), <www.phillyh2o.org/backpages/ladner1929.htm>, accessed 8 Apr 2021.
[205] Ladner died early the following year. See "Grover C. Ladner, 69, Retired Justice, Dies," *New York Times* (28 May 1954). This is the same retired Justice who earlier had instigated a lawsuit in an attempt to save the Fairmount locks and Fairmount Park land from destruction prior to the construction of the Schuylkill Expressway.
[206] The equivalent of approximately $110,900 in 2022.
[207] "Society Asks $10,000 Fund to Aid Aquarium," *Philadelphia Inquirer* (10 Apr 1953), 27.
[208] The equivalent of approximately $55 in 2022.
[209] The equivalent of approximately $2,200 in 2022.
[210] The equivalent of approximately $11,100 in 2022.
[211] The equivalent of approximately $55,500 in 2022. Since there was still no admission price, the various types of membership perhaps conferred tiered privileges to the contributors, but this is not known.

WCAU station, visited the Aquarium and was appalled at what he saw—deteriorating tanks, falling plaster, rotting floors, and a pervasive stench. Embarrassed for the city, he began complaining to anyone who would listen. When word got to Isaac D. Levy, one of the Fairmount Park Commissioners who had been working behind the scenes to improve the Aquarium, he invited Vanda to put his money where his mouth was, so to speak, and serve as a member of the Fairmount Park Aquarium Society.[212]

Vanda later said that he disliked those who never do anything to fix what they complain about; convinced that the Fairmount Park Aquarium was "an important part in Philadelphia's cultural and recreational life," he accepted Levy's invitation.[213] Within a year, he was elected president of the Society by fellow members. Under Vanda's leadership, the Fairmount Park Aquarium Society hired a fish expert to manage the daily operation.[214]

Believing a new facility was necessary if the Aquarium was to survive, the Fairmount Park Commission appropriated $40,000[215] in 1953 and hired the architectural firm Pedersen and Richards to draw up preliminary plans.[216] In 1955 it publicly announced its intention to construct a new home for the Aquarium.[217] Vanda and other members of the Fairmount Park Aquarium Society traveled to American and European cities at their own expense to study the operation and

[212] Earl Selby and Anne Selby, "In Our Town," *Sunday Bulletin* (20 Oct 1957, 4.

[213] Radio and television producer Charles Vanda (6 Jun 1903–4 Jun 1988) was in his mid-fifties during his involvement with the Fairmount Park Aquarium. See "Charles Vanda; Ex-CBS Program Chief," *Los Angeles Times* (11 Jun 1988), <www.latimes.com/archives/la-xpm-1988-06-11-mn-4160-story.html>, accessed 14 Apr 2021.

[214] Earl Selby and Anne Selby, "In Our Town," *Sunday Bulletin* (20 Oct 1957), 4.

[215] The equivalent of approximately $443,700 million in 2022.

[216] Frank Rosen, "Auto Graveyard New Museum Hit as Eyesore," *Philadelphia Inquirer* (3 Oct 1954), 41, 44 (esp. 44). Philadelphia architects Erling H. Pedersen (1899–1981) and Alfred N. Richards, Jr. (d. 1962) created the firm in 1952. See "Construction Projects: Scope and Content Note," *Philadelphia Museum of Art* (2022), <www.philamuseum.org/pma_archives/ead.php?c=fkr&s=sss129>, accessed 9 Mar 2022; "Erling H. Pedersen," *American institute of Architects Historical Directory* (28 Mar 2019), <https://aiahistoricaldirectory.atlassian.net/wiki/spaces/ahdaa/pages/35523246/ahd1034463>, accessed 11 Feb 2022; "Alfred Newton Richards, Jr.," *American institute of Architects Historical Directory* (7 Jan 2019), <https://aiahistoricaldirectory.atlassian.net/wiki/spaces/ahdaa/pages/35684585/ahd1037239>, accessed 11 Feb 2022.

[217] Fairmount Park Commission, *1955 Annual Report* (Jan 1956), 14; Earl Selby, "$750,000 Aquarium Building Planned for Fairmount Park," *Evening Bulletin* (9 Feb 1956).

management of other aquariums.[218]

In a bond referendum in November 1955, voters approved $750,000[219] for a new aquarium facility and it was included in the capital improvements program of Mayor Joseph S. Clark, Jr. The Fairmount Park Commission moved forward with a plan to build a new Aquarium approximately one hundred feet north of the Fairmount Water Works, at the site of the *Fountain of the Sea Horses*. The building would be a high-ceilinged single story, 250 feet long, faced with cream-colored marble and glass. Through a curved frontage, visitors would enter a 60 by 70 foot central exhibition lobby. The lobby would be flanked by two outer wings faced in glass front and back. It would accommodate 120 tanks, half for public display and half for support, experimental use, and reserve capacity.[220]

Vanda had a sense of style and showmanship. He grasped the dramatic potential of the new facility and understood that a combination of education and entertainment was necessary to attract visitors. He planned over sixty theatrically staged exhibits. Prospects for the Fairmount Park Aquarium looked brighter than they had in years.[221]

After Richardson Dilworth became Mayor on 2 Jan 1956, however, he announced his administration was putting the aquarium project off for a year. In September he recommended in a letter to the City Planning Commission that $450,000[222] of the funds earmarked for a new Aquarium be spent on implementation of express service on the Broad Street subway instead.[223] The head of the Planning Commission responded that he concurred with the mayor, but “the commission feels that the reconstruction of the Aquarium is a very desirable project, and that the

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[218] Morley Cassidy, “Fish Fall on Evil Days,” *Evening Bulletin* (27 Oct 1956), 6.
[219] The equivalent of approximately $8.3 million in 2022.
[220] Earl Selby, “$750,000 Aquarium Building Planned for Fairmount Park,” *Evening Bulletin* (9 Feb 1956); “Civic Leaders Rally to Save ‘Stepchild’ Aquarium,” *Philadelphia Inquirer* (15 Oct 1956), 19.
[221] Earl Selby and Anne Selby, “In Our Town,” *Sunday Bulletin* (20 Oct 1957, 4.
[222] The equivalent of approximately $4.9 million in 2022.
[223] “Fund for Express Subway Asked,” *Philadelphia Inquirer* (12 Oct 1956), 35.

postponement should be only a year or two at the most."[224] City Council did as the mayor requested and its leaders publicly doubted that the funds would ever be restored.[225]

In response, the Fairmount Park Commission in the summer of 1957 issued a request for proposals from private operators willing to run the aquarium. Not a single entity submitted a bid.[226]

One option that was considered, if only halfheartedly, was combining the management of the Fairmount Park Aquarium with that of the Philadelphia Zoo.[227] When asked about the idea, Freeman Shelley, Director of the Zoölogical Society of Philadelphia (the organization which ran the Zoo[228]), responded that it had been "discussed a little." The director explained, "At the Zoo, the Aquarium would be only one branch of operations, and would have to have its own specially trained staff. I don't think we'd want to consider it."[229]

During this time the Aquarium cost approximately $80,000 per year to run,[230] despite its reduction in size. With little support from City Council, the Fairmount Park Commission had a hard time providing the operating funds. At one of its meetings, it was reported that a visiting schoolboy had observed, "We can see better fish in a supermarket."[231] In frustration, Commissioner Levy recommended the Aquarium just be shut down. "If we can't have a first-class Aquarium," he protested, "we should close the present one. It is nothing more than a scar

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[224] "Future of Aquarium May Be Up to Public," *Philadelphia Inquirer* (16 Oct 1956), 21.
[225] "Aquarium Backers Get Setback in Council," *Philadelphia Inquirer* (14 Nov 1956), 28.
[226] "Bidders Fail to 'Nibble,' But Aquarium Held Sure," *Philadelphia Inquirer* (27 Jun 1957), 15.
[227] At least one letter-writer thought this was a good idea. See William Ernst to editor of *Evening Bulletin* (19 Oct 1956).
[228] The Zoölogical Society of Philadelphia still operates the Philadelphia Zoo. Chartered by the Pennsylvania state legislature in 1859, it is not the creation of the Fairmount Park Commission, as the Fairmount Park Aquarium Society was. See "Philadelphia Zoölogical Gardens," *Encyclopedia Britannica* (23 Aug 2013), <www.britannica.com/place/Philadelphia-Zoological-Gardens>, accessed 12 Apr 2021.
[229] Morley Cassidy, "Fish Fall on Evil Days," *Evening Bulletin* (27 Oct 1956), 6.
[230] The equivalent of approximately $843,200 in 2022.
[231] "That Crack About Better Fish in the Store Ruffles the Fins of Aquarium Denizens," *Evening Bulletin* (11 Nov 1956).

on the river bank as it now stands."[232]

Maintaining Aquarium operations in the deteriorating Fairmount Water Works increasingly looked like throwing good money after bad. Charles Vanda invited members of City Council to a lunch at the Aquarium to see for themselves the need for a new facility. Not one was willing to come. Vanda claimed the mayor even admitted to him that he'd never been there. He was beginning to suspect that improving the Aquarium was a fool's errand.

The municipal apathy stood in contrast to the public's strong support at the time,[233] but with no attempt at meaningful engagement on the part of city government, there were few opportunities for ordinary people to voice their opinions. It was relatively easy to ignore public desire on an issue like the Aquarium. Mayor Dilworth promised the new Aquarium project would be on the 1958 capital budget, which was to be released in late 1957.[234]

Not willing to give up yet, in early 1957 the Fairmount Park Commission announced a new plan to attract a commercial operator to build a new aquarium. The operator would construct a new 1.5-million-dollar facility, operate the aquarium for thirty years, and then turn it over to the City of Philadelphia. Specifications called for a one-story, stone- and marble-faced building on 1.6 acres just to the north of the Fairmount Water Works. Patterned after similar attractions in Florida and California, it would include a 60-foot-wide tank for a mix of fish and porpoises. The

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[232] "Aquarium Closing Urged on Board," *Philadelphia Inquirer* (12 Oct 1956), 29; Morley Cassidy, "Fish Fall on Evil Days," *Evening Bulletin* (27 Oct 1956), 6.

[233] "Citizens' Group Urges Funds for Aquarium," *Philadelphia Inquirer* (27 Oct 1956), 12; "City Aquarium Gets Reprieve, Prospect of Funds by '58," *Philadelphia Inquirer* (9 Nov 1956), 31. Examples of newspaper editorials during this time include "Rescue Philadelphia's Aquarium," *Philadelphia Inquirer* (14 Oct 1956); "First, Put Aquarium In Friendly Hands," *Philadelphia Inquirer* (18 Oct 1956), 12; "Now Plan New Aquarium," *Philadelphia Inquirer* (10 Nov 1956), 8. Examples of letters to the editor imploring the Aquarium be saved may be found in numerous newspaper editions including *Philadelphia Inquirer* (18 Oct 1956); *Evening Bulleting* (19 Oct 1956); *Philadelphia Inquirer* (20 Oct 1956); *Philadelphia Inquirer* (21 Oct 1956); *Philadelphia Inquirer* (24 Oct 1956); *Philadelphia Inquirer* (27 Oct 1956); *Philadelphia Inquirer* (28 Oct 1956); *Philadelphia Inquirer* (3 Nov 1956); *Philadelphia Inquirer* (4 Nov 1956).

[234] Earl Selby and Anne Selby, "In Our Town," *Sunday Bulletin* (20 Oct 1957, 4.

facility would include a 193-space parking lot onsite. Ticket prices would be limited to $1.50 for adults and 75¢ for children.[235]

"Something has to be done," Commissioner Levy remarked. "The present Aquarium is a blot on the city. There is no reason why a city such as Philadelphia—which has everything else—should have a rotten, broken-down thing like that for an aquarium."[236] Levy believed the project was important enough to civic pride that in the event no private operator could be identified, the City should run the new Aquarium. Despite an extensive outreach to prospective operators,[237] when the Commission invited bids later in June, none were submitted.[238] Neither the mayor nor City Council picked up on the idea and it was shelved.

In October 1957, when Mayor Dilworth released his administration's proposed capital budget for 1958, the new Aquarium project was included, but without any sustaining funds from the City. The Mayor proposed, oddly enough, to locate the new attraction in Old City, a neighborhood along the Delaware River just south of the Benjamin Franklin Bridge.[239]

By now thoroughly disgusted with being rebuffed at every turn by the city he had been invited to help, Vanda finally had enough. He resigned from the Fairmount Park Aquarium Society and walked away from any further involvement with the Aquarium.[240]

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[235] "Phila. To Get $1,500,000 Aquarium," *Philadelphia Inquirer* (15 Feb 1957), 1; "Delaware Valley U.S.A.," *Philadelphia Inquirer* (17 May 1957), 29. The amounts were the equivalent of approximately $15.81 and $7.90 in 2022.

[236] "Levy May Ask City to Build, Run Aquarium," *Philadelphia Inquirer* (25 Jun 1957), 1, 15.

[237] Saul Kohler, "Held Together By Chewing Gum: City's Aquarium Dying of Neglect," *Philadelphia Inquirer* (19 Jun 1957), 1, 25.

[238] "Bidders Fail to 'Nibble,' But Aquarium Held Sure," *Philadelphia Inquirer* (27 Jun 1957), 15.

[239] "Mayor Presents Capital Program Topping $79 Million," *Philadelphia Inquirer* (11 Oct 1957), 45. Filled with historic buildings, Old City was a curious choice for the location of a new Aquarium. Philadelphia, however, seems to have a long legacy of its civic leaders and citizenry alike giving little thought to historic structures that are not connected to the Revolutionary Era. At this same time, for example, at the western edge of Old City, approximately one and a half of the eventual three blocs immediately north of Independence Hall had already been cleared of all buildings in preparation for the construction of Independence Mall. And it wouldn't be long before construction of Interstate 95 through the Delaware Riverfront would plow through the eastern edge of this neighborhood. Together, both projects would result in the wholesale destruction of hundreds of irreplaceable structures.

[240] Earl Selby and Anne Selby, "In Our Town," *Sunday Bulletin* (20 Oct 1957), 4.

With the majority of the saltwater fish killed during the trouble with the installation of the new heating equipment in 1956, the remaining marine species were now transferred to tanks in the Old Mill House and the New Mill House was permanently closed.[241] With the Engine House closed since 1949, the Old Mill House was now the only portion of the Fairmount Aquarium still open to the public. The contraction, of course, had the effect of giving the public even less of a reason to visit than before. Commissioner Levy candidly echoed the complaint of schoolboy a year earlier. "There isn't a delicatessen in Philadelphia that doesn't have a better collection of fish," he lamented. "If you sold all our fish on the open market," Superintendent Lindaman agreed, "you would get less than fifty dollars for the whole lot."[242]

The diminished facility now cost $50,000 per year to operate,[243] $30,000 less than what had been reported a year earlier. In a further effort to lower costs, the Fairmount Park Commission at the end of the year reduced the public hours from seven days a week to five. Eliminating Mondays and Tuesdays was expected to trim another $6,000 from the annual operating expenses,[244] mostly from savings in overtime pay. John B. Kelly, Vice President of the Commission, suggested the Aquarium be closed altogether, but a majority of the commissioners decided it was still a going concern and they voted to keep it open.[245]

By this time, however, the Aquarium had acquired a reputation for not just being shabby but unsafe as well and it became less of a draw than ever. Attendance continued to trend downward. In 1958, the last year the Fairmount Park Commission reported attendance, the total

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[241] Fairmount Park Commission, *1957 Annual Report* (Jan 1958), 31.
[242] Saul Kohler, "Held Together By Chewing Gum: City's Aquarium Dying of Neglect," *Philadelphia Inquirer* (19 Jun 1957), 1, 25.
[243] The equivalent of approximately $527,000 in 2022.
[244] The equivalent of approximately $63,200 in 2022.
[245] Fairmount Park Commission, *1957 Annual Report* (Jan 1958), 14; Fairmount Park Commission, *1959 Annual Report* (Jan 1960), 37; "Aquarium to Close Mondays and Tuesday [*sic*] to Save Funds," *Evening Bulletin* (10 Dec 1957), 52; "Park Board to Close Aquarium 2 Days Weekly," *Philadelphia Inquirer* (10 Dec 1957), 11.

number of visitors had dropped to a little over 267,000.[246]

In October of 1958, Mayor Dilworth's proposed capital budget for 1959 contained nothing for any type of new Aquarium project.

Two months later an unidentified foundation proposed to build a $3 million[247] aquarium facility on an eight-acre site on the Ben Franklin Parkway between the Art Museum and 24th Street. Part of Fairmount Park property, the land would be leased to the group by the Fairmount Park Commission and the building would eventually revert to the City. Commission chairman John B. Kelly created a committee to evaluate the offer.[248] It must not have been considered viable because nothing more was heard about it.

A year later, on 14 Dec 1959, Fairmount Park Commissioner Levy briefed the Commission on his efforts to save the Aquarium. He had developed a plan by which a nonprofit corporation would be set up to borrow $2 million.[249] The organization would build a new aquarium facility and operate the aquarium, repaying the loan from earnings from admission fees and concession rentals. Analyzing the financials, Levy anticipated the loan would be paid off within three years. First Pennsylvania Banking and Trust Company President William F. Kelly and Philadelphia National Bank Executive Vice-President John McDowell had agreed to the loan. The result, as Levy put it, was that the City of Philadelphia would get and aquarium "twice as large as the one at Coney Island" without putting up any money of its own.

Mayor Dilworth initially approved the financing plan. It all seemed settled, but the plan suddenly fell apart. Levy believed the mayor had scuttled it at a secret meeting in City Hall to

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[246] Fairmount Park Commission, *Annual Reports,* 1947–1958. Annual attendance in 1958 was 267,312.
[247] The equivalent of approximately $30.7 million in 2022.
[248] "Park Offered New Aquarium," *Evening Bulletin* (23 Dec 1958); "Two-Way Traffic OKd On West River Drive," *Philadelphia Inquirer* (23 Dec 1958), 1.
[249] The equivalent of approximately $20.4 million in 2022.

which Levy had not been invited. “They didn’t invite me because they knew I could answer their objections,” he complained bitterly to his fellow commissioners. “They just decided for a thousand reasons, none of which were valid, not to do it.”[250]

Robert Crawford, head of the Department of Recreation, the City agency to which the Fairmount Park Commission was nominally accountable, wondered publicly what secret meeting Levy was talking about. He said he had personally attended the meeting to which Levy referred, which took place in the Mayor’s office and involved other projects besides the Aquarium.[251] Not only was the new Aquarium project not killed, Crawford contended, the discussion involved ways the City could support it. “We were trying to explore resources which could be used to finance these projects,” Crawford asserted. “As a matter of fact, we are trying to bring the aquarium and other projects to fruition.” Others who attended the meeting, according to Crawford, included the Mayor, Managing Director, City Solicitor, Deputy Director of Commerce, Vice Chairman of the City Planning Commission, the City Representative and his deputy, and the Executive Vice President of the Philadelphia Industrial Development Corporation.[252]

Secret or not, Levy was apparently correct when he claimed he had not been invited. One person who had been invited but for some reason did not attend, however, was Harry Kalish, attorney and former member of the City Planning Commission, who had worked with Levy on the plans for the new Aquarium.[253]

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[250] “Park Board Moves to Close Long-Criticized Aquarium,” *Evening Bulletin* (14 Dec 1959), 3.
[251] Other projects included the restoration of Fort Mifflin, the Delaware River Marina, and “Liberty Land,” a proposed children’s theme park attraction.
[252] “Closing of Aquarium Not a Certainty; Top officials Pledge Study,” *Philadelphia Inquirer* (16 Dec 1959), 1, 60. The Managing Director pointed out that if the new Aquarium project was indeed self-sustaining as claimed, there would be little need for financial support from the City, but since the City would be required to underwrite it, the project would need to be included in the capital budget.
[253] “Closing of Aquarium Not a Certainty; Top officials Pledge Study,” *Philadelphia Inquirer* (16 Dec 1959), 1, 60.

City Council President James Tate suggested that instead of being rejected, the plans merely "got lost somewhere," perhaps in the offices of the City Planning Commission or the Managing Director. Ed Bacon, head of the City Planning Commission, responded that while his agency had attended preliminary discussions, there had been no presentation of a "formal recommendation."[254] The Managing Director claimed he had never seen any plans.[255] It was a classic case of circular finger pointing.

More credibly, Council President Tate said, "We have not at any time been apprised officially of any of the details of [Commissioner Levy's] proposal." Council would be "very happy," Tate offered, for Levy to present the plan to the body.[256]

In a burst of frustration over what he perceived as the seeming determination on the part of the Mayor's administration and City Council to sabotage any initiative by the Fairmount Park Commission to extend the life of the Aquarium, at the December 1959 meeting of the Fairmount Park Commission, Commissioner Levy introduced a motion to immediately close the Aquarium. He called it "a rat-infested monstrosity" unsafe for school children.[257] He was not exaggerating. At the next meeting of the Fairmount Park Commission less than a month later,[258] Park Director William H. Noble reported that the Philadelphia Health Department was cleaning up the area and had so far killed twelve rats.[259] Referring to the dwindling fish population, Levy repeated his earlier gripe. "You can go to any delicatessen and find more."[260] After Philadelphia Water Department Commissioner Samuel S. Baxter (an ex-officio member of the Fairmount Park

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[254] "Jealousies at City Hall Scuttle Aquarium, Park Official Charges," *Philadelphia Inquirer* (15 Dec 1958), 1, 15.
[255] "Closing of Aquarium Not a Certainty; Top officials Pledge Study," *Philadelphia Inquirer* (16 Dec 1959), 1, 60.
[256] "Closing of Aquarium Not a Certainty; Top officials Pledge Study," *Philadelphia Inquirer* (16 Dec 1959), 1, 60.
[257] "Park Board Moves to Close Long-Criticized Aquarium," *Evening Bulletin* (14 Dec 1959), 3; "Jealousies at City Hall Scuttle Aquarium, Park Official Charges," *Philadelphia Inquirer* (15 Dec 1958), 1, 15.
[258] "City Aquarium Will Stay Open," *Evening Bulletin* (11 Jan 1960).
[259] It is not known if they were rodents of unusual size.
[260] "Park Board Moves to Close Long-Criticized Aquarium," *Evening Bulletin* (14 Dec 1959), 3.

Commission) warned against acting in haste, the Commission decided instead to appoint a committee to study the issue further.[261]

A month later the Commission ordered another stay of execution. The members voted unanimously on 11 Jan 1960 to keep the Aquarium open a little longer. Commission President Kelly moved to "keep operating and keep it fixed up until somebody builds us another one."[262]

Three months later, Harry Lindaman retired as superintendent of the Aquarium.[263] Leo McDermott, who had been on staff since the early 1930s, replaced him.[264]

Work continued behind the scenes to keep the Aquarium alive. On 9 Apr 1960, Mayor Dilworth publicly announced an agreement for construction of a new, four-acre, $2 million[265] Aquarium on a 15-acre tract of Fairmount Park land at 40th Street and Parkside Avenue, near Memorial Hall and the Philadelphia Zoo.[266] The site also featured easy access to and from the brand-new Schuylkill Expressway. The new facility, designed by local architect Leonard A. Shaffer, would be large enough to accommodate seals, walruses, and even whales. Two days later the Commission enthusiastically approved the arrangement.

Under this plan, Commissioner Levy would serve as unpaid head of the board of directors of Philadelphia Aquarium, Inc.[267] The attraction would be built and operated by the

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[261] "Jealousies at City Hall Scuttle Aquarium, Park Official Charges," *Philadelphia Inquirer* (15 Dec 1958), 1, 15.
[262] "City Aquarium Will Stay Open," *Evening Bulletin* (11 Jan 1960), 3; "Park Board to Repair Aquarium and Keep It Open," *Philadelphia Inquirer* (12 Jan 1960), 21.
[263] "Today We Remember," *Philadelphia Inquirer* (20 Nov 1960), 188.
[264] Robert J. Salgado, "Once-Thriving City Aquarium is Deserted," *Evening Bulleting* (19 Dec 1969); James Smart, "Leo's at the Helm Of an Aquarium Without Any Fish," *Sunday Bulletin* (10 Dec 1972), 7; "Leo McDermott [obituary]," *Philadelphia Inquirer* (14 Jun 1977), 24.
[265] The equivalent of approximately $20 million in 2022.
[266] This is the current location of the School of the Future, a public school in the Philadelphia School District designed to serve as an innovation and technology testbed.
[267] Other directors on the board included John B. Kelly, Jr., President of the Fairmount Park Commission; William McCloskey, son of Matthew H. McCloskey; Robert P. Levy, Commissioner Levy's nephew; attorneys Benedict Gimbel, Harry A. Kalish, and James A. Sutton; and Harry Rieger, President of the Germantown Community Council. See William F. Feist, "New Aquarium to be Built On Park Site," *Philadelphia Inquirer* (10 Apr 1960), 21, 26.

corporation. Upon completion of construction, the corporation would turn the building over the City of Philadelphia which would lease it back to the corporation for a forty-year period for an annual rental fee of $30,000.[268] At the end of the forty years, the corporation would have the option to renew the lease for an additional twenty. The corporation would have the ability, with Fairmount Park Commission approval, to contract for food, beverage, and souvenir concessions. Admission would be charged, but discount tickets would be offered to children and groups. No members of the corporation's board of directors, including Levy, would be allowed to own stock in the enterprise. Investment firm Stroud & Co. would underwrite the project.

Art Commission approval of the building plan was required, but construction was anticipated to begin in the summer of 1960 and take approximately a year to complete. The only real piece of the puzzle left was approval by City Council.[269]

On 27 July City Council turned the proposal down.[270]

The reasons given included dissatisfaction with the lack of municipal controls over profits and misgiving over the use of public land by a private entity. Council also sought to shorten the term of the lease to ten years, after which time the City would reimburse Philadelphia Aquarium, Inc. for its investment, less depreciation, and add a 25 percent profit. The corporation decided the modified terms were too risky and rejected the offer.

At bottom, City Council just didn't think the plan made financial sense. Its Committee on Public Property and Public Works reported:

> At first blush it would appear the city was acquiring an expensive facility free of charge.

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[268] The equivalent of approximately $300,200 in 2022.

[269] William F. Feist, "New Aquarium to be Built On Park Site," *Philadelphia Inquirer* (10 Apr 1960), 21, 26; "New Aquarium OKd by Park," *Evening Bulletin* (11 Apr 1960). City Council's approval was required because the City of Philadelphia would hold the title to the facility.

[270] "Profit Hassle Dampens OK For Privately-Run Aquarium," *Philadelphia Daily News* (27 Jul 1960), 3; "Council Kills Plan for $2,000,000 Private Aquarium," *Philadelphia Inquirer* (28 Jul 1960), 35; "Levy Vows to Build Private Aquarium," *Philadelphia Daily News* (30 Jul 1960), 12.

> Further examination, however, puts an entirely different light on the transaction. If a facility of the magnitude contemplated by the corporation were constructed on privately owned ground, it would undoubtedly justify an assessment of $1 million, which would result in an annual real estate tax bill in excess of $30,000. The only thing the city would receive in return for the use of the ground and the guaranteed ceiling on real estate taxes would be the doubtful residual value of the plant after 60 years' use by the corporation.[271]

Calling the decision by City Council "unfortunate," Mayor Dilworth said that there was simply no prospect of the City coming up with the funds required to build a new Aquarium itself anytime in the next six years, the forward-looking timeframe of the City's budget process. This meant that the new Aquarium project was dead.

Three days after City Council's decision, Levy promised to build an aquarium with or without the City's help. Philadelphia Aquarium, Inc. will build "a modern aquarium in this city on privately-owned ground," Levy declared. "It's important Philadelphia has one. If the city doesn't want one, we'll do it ourselves."[272]

By 1961 the New Mill House had been closed to the public for four years. Recognizing that an empty building tends to quickly deteriorate, the Fairmount Park Commissioners decided on 8 May of that year to accept a proposal by John B. Kelly, Jr., to create a pool in the interior space.[273] Kelly had created the John B. Kelly Foundation in honor of his father who had died the

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[271] "Council Kills Plan for $2,000,000 Private Aquarium," *Philadelphia Inquirer* (28 Jul 1960), 35.

[272] "Levy Vows to Build Private Aquarium," *Philadelphia Daily News* (30 Jul 1960), 12. Levy was as good as his word. With Stroud & Co., Philadelphia Aquarium, Inc. raised funds from private investors through the sale of stock and in December 1962 opened the Aquarama, a privately run aquarium attraction, featuring a variety of fish, penguins and other aquatic animals, and even dolphins on a ten-acre parcel at the northwest corner of Broad and Hartranft Streets in south Philadelphia. Although popular, it was not financially successful and closed just after Thanksgiving, 1969. See "Aquarama Plans Regular Schedule," *Philadelphia Inquirer* (26 Dec 1962), 24; "Rift With City Could Force Aquarama Out of Business," *Philadelphia Inquirer* (2 Jan 1967), 4; "Aquarium Never a Success," *Philadelphia Inquirer* (21 Dec 1967), 38; "Student Requests Stall Closing of Aquarama," *Philadelphia Daily News* (28 Oct 1969), 39; "Last 2 Days; Aquarama," Philadelphia Daily News (29 Nov 1969), 15.

[273] "Swimming Pool at Aquarium Approved by Park Board," *Evening Bulletin* (9 May 1961), 28.

previous summer. The elder Kelly had been President of the Fairmount Park Commission at his death.[274]

The foundation's first project, the pool would be constructed and maintained by the foundation. Any profits after expenses would be turned over to the City. The pool would be used by students from area schools during the day and by amateur swimmers and the general public in the late afternoon and early evening. In a city without a single all-weather public pool, offering year-round access to swimming instruction was a primary goal.[275] Although City Council received contradictory advice from the City Planning Commission, it eventually approved the plan with the provision that no alterations would be made to the exterior of the building.[276]

The John B. Kelly Foundation signed a ten-year lease with the Fairmount Park Commission for the interior of the New Mill House and funded the construction of the pool entirely from its own coffers. To save money on expenses, Kelly had his own construction company, John B. Kelly, Inc. (which he had inherited from his father), perform most of the necessary work. In early 1961, Kelly projected the pool would cost between twenty and twenty-five thousand dollars and be open by September. In the end, demolition of the display tanks and construction of the 75- by 35-foot pool and supporting equipment cost $45,000.[277] Although

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[274] John B. (Jack) Kelly (4 Oct 1889–20 Jun 1960) was a repeat Olympic rowing champion, successful construction contractor, and physical fitness advocate. Active in local Democratic politics, he was the father of four children—Margaret (Peggy), John (Jack), Jr., Grace (the actress), and Elizabeth. See "John B. Kelly is Dead of Cancer," *Philadelphia Inquirer* (21 Jun 1960), 1, 3. Incidentally, East River Drive was renamed Kelly Drive in honor of Jack, Jr., in 1987, following his death in 1985. See "The Latest Word on the River Drives," *Philadelphia Inquirer* (4 Mar 1989), B14.

[275] "New City Pool Opens Today," *Philadelphia Daily News* (19 Dec 1961), 59.

[276] William A. Forsythe, "Aquarium Pool Blocked by Backer of Marina," *Evening Bulletin* (7 Jun 1961). Oddly, although the City Planning Commission's staff recommended approval (with the exterior proviso), Commission Vice-Chairman Phillip Klein persuaded all of his fellow commissioners to recommend disapproving the pool on the basis that it was not part of an integrated plan to reuse the entire Fairmount Water Works complex of buildings. This caused a delay in Council's approval. At the time, Klein was leading Philadelphia Marina, Inc., a non-profit organization that claimed it was willing to spend a million dollars to establish a recreation area it was planning at Fairmount. The attraction would have included a roller rink, ice skating rink, fishing pool, and exhibit on Philadelphia's history.

[277] The equivalent of approximately $445,700 in 2022.

swimmers were using it as early as 10 Dec,[278] the pool was officially opened to the public on 19 December 1961, to Mayor Dilworth's firing of a starter's pistol to commence a celebratory race.[279]

Lacking an official name, the pool in the New Mill House has often been confused in public awareness with the John B. Kelly Natatorium, a much larger outdoor pool opened in 1956 next to Memorial Hall.[280] Less forgivable was official misinformation. In a display of the Fairmount Park Commission's ignorance of its own facilities, Fairmount Park Director William H. Noble erroneously stated in the Commission's Annual Report for 1964 that when a new pool had opened that year inside Memorial Hall, "Mayor Tate was the principal speaker and a large group of Commissioners, headed by [Fairmount Park] Commission President Mann and many notables of the swimming world, were on hand to inaugurate the first indoor swimming pool built with city funds."[281] To the contrary, the pool in the New Mill House was of course the first such facility.

On 20 Jun 1962, the summer after the pool opened, all of the Aquarium's remaining marine specimens died, including its collection of sharks, possibly from chlorine contamination from the pool. Some wondered if chlorine contamination from the pool was to blame, but Fairmount Park Director Noble was quick to dismiss the idea. Later, however, he admitted that it was a possibility. The Aquarium was closed temporarily at midday for public safety's sake.[282]

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[278] "Now It's for Human Fish," *The Philadelphia Inquirer Magazine* (10 Dec 1961).

[279] Fairmount Park Commission, *1961 Annual Report* (Jan 1962), 13f; "Aquarium Swimming Pool Opens With a Bang," *Evening Bulleting* (20 Dec 1961). See also Ruth Seltzer, "The Philadelphia Scene…" *Philadelphia Inquirer* (10 Dec 1961).

[280] The John B. Kelly Natatorium is still a popular place to swim.

[281] Fairmount Park Commission, 1964 Annual Report (Jan 1965), 4; "City's First Indoor Swimming Pool," Philadelphia Inquirer (19 Apr 1964), 201.

[282] "Pollution Kills all Salt Water Fish at Aquarium," *Evening Bulletin* (20 Jun 1962); "Polluted Water Kills 100 Fish," *Philadelphia Inquirer* (21 Jun 1962), 34; "Old Home Dying: Aquarama Will Open in Fall," *Philadelphia Inquirer* (1 Jul 1962), 23, 27. The marine specimens were at this time displayed next door in the Old Mill House.

After an investigation was conducted and steps taken to prevent a reoccurrence , the Aquarium was reopened two weeks later. Ironically, however, its marine collection was temporarily restocked with specimens borrowed from the soon-to-open Aquarama, Isaac Levy's commercial aquarium attraction in south Philadelphia.[283]

Prospects for the Aquarium were poor. All attempts to save it had failed. There were few fish, few visitors, and a deteriorating facility.

At the end of the year, after what had been a prolonged, painful, and very public decline, the Fairmount Park Commission finally delivered the *coup de grace* and put the Fairmount Park Aquarium out of its misery. It was shut it down at the end of the last day of the year 1962.[284] All of the remaining fish—which were few—were donated to the Aquarama,[285] which had opened earlier in the week.[286]

In hindsight, it's surprising the Fairmount Park Aquarium lasted as long as it did. It was located in a difficult place to operate an aquarium attraction.[287] The facility was dogged by a crushing maintenance burden. It had to endure recurring, disruptive flooding.[288] Obtaining a

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283 Charlie Bannister, "Fresh Salt-Water Fish Give Aquarium New Life," *Philadelphia Daily News* (11 Jul 1962), 45.

284 "Park Aquarium Closing Monday," *Philadelphia Inquirer* (28 Dec 1962), 23; "The Aquarium Closes," *Philadelphia Inquirer* (29 Dec 1962).

285 "Old Aquarium Shuts Tuesday," *Evening Bulletin* (27 Dec 1962).

286 "Aquarama Plans Regular Schedule," *Philadelphia Inquirer* (26 Dec 1962), 24; James Smart, "Fish May Swim Again at Old Phila. Aquarium," *Evening Bulletin* (20 Oct 1972). The Aquarama opened in December 1962 on South Broad Street just above today's sports complex. It closed at the end of November 1969. See "Aquarama Plans Regular Schedule," *Philadelphia Inquirer* (26 Dec 1962), 24; "Last 2 Days; Aquarama," *Philadelphia Daily News* (29 Nov 1969), 15.

287 This was recognized as early as 1944 when a new, $110,000 facility was suggested in order to overcome the challenges posed by the Aquarium's location. See Frederick V. Lewis, "Silt Turns River Into an Eyesore," *Philadelphia Inquirer* (7 Nov 1944), 19.

288 There were at least six serious flood events at Fairmount during the Aquarium and pool years. See National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1.

Date	*Crest Height Above Fairmount Dam*	*Hurricane?*
24 Aug 1933	14.70 inches	Chesapeake-Potomac
9 Jul 1935	14.10 inches	No
2 Jun 1946	14.57 inches	No

reliable supply of healthful fresh and salt water was difficult, as was maintaining a large enough population of healthy freshwater fish, tropical marine fish, and other aquatic animals. Specimen die-offs occurred with distressing frequency. And chronic underfunding made everything just that much more difficult. In today's vernacular, we would call it unsustainable. That it survived as long as it did—just over 51 years—is a testament to the skill, hard work, and determination of the Aquarium staff and leadership over those five decades.

The Aquarium's closure left only the New Mill House in active use. Approximately ten years later, in June of 1972, Pennsylvania and the mid-Atlantic region was lashed by Hurricane Agnes. The massive storm stalled over the central and eastern portions of the state[289] and caused extensive flooding.[290] At eight o'clock in the morning of 23 Jun, the Schuylkill River crested at 14.65 feet above the level of Fairmount Dam.[291] Although the building itself shrugged off the assault, water inundated the interior, rising to eight feet above the floor and leaving two inches of mud over everything. The flooding wrecked three large boilers and pushed a 15,000-gallon oil tank through a 12-inch-thick brick wall in the heating plant in the Old Mill House.[292] Wiring and electrical fixtures were ruined. The filtration, heating, ventilation, and electrical systems were all

15 Nov 1950	14.32 inches	No
19 Aug 1955	14.32 inches	Diane
23 Jun 1972	14.65 inches	Agnes

[289] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (National Oceanic and Atmospheric Administration, 14 Jan 2020), 1. Eighteen inches of rain fell in portions of upstate Pennsylvania during the period 20–25 Jun 1972.

[290] Jeremy Heymsfeld and Mike Leary, "Tropical Storm Kills 47 on East Coast," *Philadelphia Inquirer* (23 Jun 1972), 1, 4; Bill Collins, "The Schuylkill: A Writing, 100-Mile-Long Monster," *Philadelphia Inquirer* (24 Jun 1972), 3; "30 Dead, 200,000 Homeless in State: State of Disaster Declared, Harrisburg Under Curfew," *Philadelphia Daily News* (24 Jun 1972) 3, 6; "Massive Cleanup Under Way Across State," *Philadelphia Inquirer* (26 Jun 1972), 3.

[291] *Hurricane Agnes Rainfall and Floods, June–July 1972: Geological Survey Professional Paper 924* (Washington, D.C.: U.S. Geological Survey and National Oceanic and Atmospheric Administration, 1975), 99. As bad as flooding from Hurricane Agnes was, it did not produce the highest water level in recorded Fairmount history up to that time. The highest mark belongs to the 17-foot crest on 4 Oct 1869 during the Saxby Gale Hurricane.

[292] The plant had supplied heat for both the Aquarium and the Philadelphia Museum of Art. In response to the destruction, the plant was abandoned and museum officials switched to purchased steam for its heating. See Fairmount Park Commission, *1971–72 Annual Report* (2 Jan 1973), 23.

destroyed.[293] The pool was closed and never reopened.

The buildings of the Fairmount Water Works fell silent once more.

[293] James Smart, "Leo's at the Helm Of an Aquarium Without Any Fish," *Sunday Bulletin* (10 Dec 1972), 7.

CHAPTER 13

UNCERTAINTY AND RESTORATION

On a bright summer day in 1974, a woman named Susan Myers (1924–2009) rode with her husband down the Schuylkill Expressway[1] on the way from their Main Line home to a weekend at the New Jersey shore. A little over three years earlier[2] the couple had moved back into the area with their four children after living for a time in Chattanooga, Tennessee and then Atlanta, Georgia.[3] As they approached Center City Philadelphia along the western bank of the Schuylkill River, a set of buildings on the other side of the water caught Susan's eye. She had noticed them before, of course, but until now hadn't given them much thought. That day, however, the sun seemed to magnify their obvious state of decay. Intrigued by the buildings, Susan wondered aloud what they were. "That's where the old aquarium was," replied her husband, "the Fairmount Water Works."[4]

It had been nearly twelve years since most of the buildings of the Fairmount Water Works had seen any real activity. The pool in the New Mill House, the only remaining portion in use during the intervening years, had been closed for almost two years since Hurricane Agnes had swept through. Most of the complex—the Engine House and the Old Mill House—had been

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[1] Then as now, the Schuylkill Expressway was designated Interstate 76 (I-76) as part of the National System of Interstate and Defense Highways (commonly called the Interstate Highway System).

[2] Susan Myers transferred her membership in the Junior League from the Atlanta chapter to the Philadelphia chapter in December 1970. See Junior League of Philadelphia, *1970 Annual Report* (Spring 1970), handwritten annotations at 112, 164.

[3] Before moving to Tennessee, they lived in Wynnewood, Gladwyne, and Devon. Upon their return, the family settled in Berwyn. All are on the so-called Main Line (an area northwest of Philadelphia named after the Main Line of Public Works, a Pennsylvania state-sponsored railroad improvement that sparked early development in the area).

[4] Leonard W. Boasberg, "Waterworks Restoration Moves Into Phase Three," *Philadelphia Inquirer* (20 Jul 1989), 30, 33; "George C. Myers," *Philadelphia Inquirer* (12 Oct 2007), B11; Sally A. Downey, "Susan W. Myers, 84; Led Waterworks Restoration," *Philadelphia Inquirer* (21 Jan 2009), B9; "Susan Wiener Myers," Monaghan Funeral Home (unknown date), <http://www.monaghanfuneralhome.com/obituaries/print?o_id=4856781>, accessed 16 Aug 2021.

vacant since the end of 1962 when the Fairmount Park Aquarium had closed. Leo McDermott, the municipal attraction's last Superintendent, puttered around the empty halls doing his best to maintain some semblance of upkeep,[5] but a promising three-year effort by a nonprofit organization to resurrect the Aquarium had recently come to naught.[6] Without funding or visitors, Fairmount slowly deteriorated.[7]

Without an active draw, fewer people visited the area behind the Philadelphia Museum of Art. Fewer climbed down the cliffside paths. Fewer strolled the South Garden. Occasionally people would fish from the downstream side of the Mound Dam.

The Park Guard, once the pride of the Fairmount Park Commission,[8] had been ended as a separate police force in 1972, during the administration of Mayor Frank L. Rizzo, and its 525 officers absorbed into the Philadelphia Police Department.[9] The Park Guard had enforced park regulations and looked after visitors, but a regular police force has other priorities. Vandalism, already a rising problem,[10] accelerated after the consolidation and there was a perception of decreased public safety within the park system.

In 1975, the Fairmount Park Commission received from the City of Philadelphia only $2

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[5] James Smart, "Leo's at the Helm of an Aquarium Without Any Fish," *Sunday Bulletin* (10 Dec 1972), 7.

[6] Led by John Cornell, the volunteer Fairmount Park Aquarium Society signed a ten-year agreement with the Fairmount Park Commission, and even managed to keep fish in some of the Aquarium's old tanks, but didn't survive past 1974. See James Smart, "Fish May Yet Swim Again at Old Phila. Aquarium," *Evening Bulletin* (20 Oct 1972); Park Approves Plan for Flower Show in 1976," Evening Bulletin (13 Sep 1973); Judith Kinnard, "Volunteers Work to Reopen Old City Aquarium," *Philadelphia Inquirer* (23 Jun 1974), 17.

[7] "Preservation: Something Worth Saving," *Philadelphia Inquirer* (13 Dec 1976), courtesy Special Collections Research Center, Temple University Libraries.

[8] "Fairmount Park Guards Have a Strenuous Job," *Philadelphia Record* (14 Aug 1910), 1ff, courtesy Special Collections Research Center, Temple University Libraries; "Park Guards on Parade," (28 Jun 1944), courtesy Special Collections Research Center, Temple University Libraries.

[9] Don McDonough, "O'Neill Gets Control of Park Guards," *Philadelphia Inquirer* (10 Feb 1972); Paula Herbut, "Park Board OKs Merger of Police with City Force," *Evening Bulletin* (11 May 1972), courtesy Special Collections Research Center, Temple University Libraries; Paula Herbut, "Cella Quits as Head of Park Police, Blasts 'Merger' With City Force," *Evening Bulletin* (13 Apr 1972), courtesy Special Collections Research Center, Temple University Libraries.

[10] Donald A. McDonough, "Parks Battle Vandalism," *Philadelphia Inquirer* (24 Mar 1968), courtesy Special Collections Research Center, Temple University Libraries; "In Parks, 'Vandalism Breeds More Vandalism,'" *Evening Bulletin* (15 Dec 1969), courtesy Special Collections Research Center, Temple University Libraries.

million[11] for maintenance of park assets across the entire sprawling Fairmount Park system. Not a single capital dollar of that amount that year was dedicated to the Fairmount Water Works.[12]

In the mid-1970s, the Fairmount Water Works was in an obvious state of neglect. The buildings were falling apart and tagged with graffiti, and the grounds suffered the ravages of vandalism.[13] Maintenance was nearly nonexistent. It became increasingly evident that both the buildings and grounds were not receiving the attention they warranted. Susan Myers would later recount that from across the river, during rainy weather the buildings looked like they had "weeping eyes, crying out for help."[14]

Around this time, Philadelphia began to experience a ripple effect from the Pennsylvania Railroad's demolition of its grand train station in Manhattan during the previous decade. Razed between 1963 and 1966, the destruction of such a magnificent and beloved structure in the heart of a major American city shocked many and kick-started the historic preservation movement in America.[15] Simultaneously, anticipation of the bicentennial of the founding of the United States caused a renewed appreciation for American history and the physical landscape related to it.[16]

To be sure, the area around Fairmount hadn't been completely abandoned, of course. A

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[11] The equivalent of approximately $11 million in 2022.

[12] "Water Works Repairs," Evening Bulletin (12 Oct 1978), courtesy Special Collections Research Center, Temple University Libraries, referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 40n.111.

[13] Nels Nelson, "Beauty at Fairmount: Enjoy! Enjoy!" *Philadelphia Daily News* (18 Apr 1974), 26.

[14] Sally A. Downey, "Susan W. Myers, 84; Led Waterworks Restoration," *Philadelphia Inquirer* (21 Jan 2009), B09; Pareidolia is the technical term for the human tendency to perceive meaningful images, often human-like faces, in inanimate objects or ambiguous visual patterns. See *Merriam-Webster* (2022), <www.merriam-sebster.com/dictionary/paeidolia>, accessed 25 Mar 2022.The river side of the Fairmount Water Works does indeed look to many people as if it has faces in it, three to be exact.

[1515] Nick Bryant, "How Penn Station Saved New York's Architectural History," *BBC News* (28 May 2015), <www.bbc.com/news/magazine-32890011>, accessed 28 Mar 2022; "Cultural Landscapes: Laying the Preservation Framework, 1960–1980," *National Park Service* (U.S. Department of the Interior, 26 Jul 2017), <www.nps.gov/subjects/culturallandscapes/cltimeline4.htm>, accessed 28 Mar 2022.

[16] Milton M. Klein, "Commemorating the American Revolution: The Bicentennial and Its Predecessors," *New York History,* Vol. 58, No. 3 (Jul 1977), 257ff; "U.S. Bicentennial, 1976," *The Inclusive Historian's Handbook* (2 Jul 2019), <http://inclusivehistorian.com/u-s-bicentennial-1976>, accessed 22 Jan 2021.

few things that were perceived at the time as improvements had been accomplished since the Aquarium had closed.

The bi-level Spring Garden Street Bridge (known as the Callowhill Street Bridge when it was completed in 1875), for example, was replaced from 1964 to 1966. During the planning for the Schuylkill Expressway in the late 1940s and early 1950s, it was recognized that the old bridge would not be able to hand the increase in traffic expected to result from the connection with the new highway at the bridge's western end. When the expressway would be opened to traffic, the old bridge would become functionally obsolete virtually overnight. The bridge would be able to handle the weight but would be a major congestion bottleneck.

Until the mid-1950s the intention was to modify the old bridge by widening it to four lanes (two in each direction) on both the upper and lower levels. This was estimated to cost \$65,000.[17] By 1959, however, the City of Philadelphia decided to replace the old bridge altogether,[18] for multiple reasons. This was an important pedestrian crossing, but the outer wood walkways would have been eliminated. The new vehicle lanes would have been only ten feet wide even without the walkways, dangerously narrow. And there still would have involved the difficult engineering challenge of removing a key structural column at the eastern end; without this modification, eastbound traffic would continue to be forced to negotiate an exceptionally tight right turn upon leaving the bridge. Considering that the bridge had been a maintenance headache since the 1930s and the western end had been replaced in 1957 by the Pennsylvania

[17] Frank Rosen. "Schuylkill Span to Be Widened," *Philadelphia Inquirer* (21 Nov 1954), 42, 61. The amount is The equivalent of approximately \$715,600 in 2022.
[18] "New Spring Garden St.," *Philadelphia Inquirer* (4 Mar 1959), 24.

Department of Highways[19] during construction of the Schuylkill Expressway,[20] a wholesale replacement of the entire structure seemed prudent.

Changes to the roadway configuration on the east side of the Schuylkill River, however, moved the concept of a new bridge from the merely sensible to the outright necessary. In order to better manage the complex flow of traffic at the point where the Parkway terminated in front of the Art Museum, an expanded circle was planned. Eventually called Eakins Oval, it was part of a $5 million project[21] which included widening Spring Garden Street from Broad Street west to Eakins Oval at the Art Museum, converting a disused trolley tunnel to vehicular use, and constructing two grade-separated roadways on the west side of the Art Museum leading to the Spring Garden Street Bridge.[22] Instead of connecting to a single bridge, this last pair of roadways would connect to two separate bridges, one for a higher-level Spring Garden Street crossing and another for a lower-level West River Drive.[23] The new Spring Garden Street Bridge would connect with the Mantua and Powelton Village neighborhoods and the ramps to and from the Schuylkill Expressway on the west side of the river, more or less on the alignment of the old bridge. A new West River Drive Bridge would be tucked underneath the Spring Garden Street span, on a skewed alignment that would provide a more fluid connection on both sides of the river.[24]

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[19] Today known as the Pennsylvania Department of Transportation, or PennDOT.
[20] Frank Rosen. "Schuylkill Span to Be Widened," *Philadelphia Inquirer* (21 Nov 1954), 42, 61; "Floating Bridge to Close Spring Garden Span 10 Days," *Philadelphia Inquirer* (12 May 1957), 25, 27; *Philadelphia Inquirer* (19 May 1957), photograph at 49; "W. River Drive, Lower Level of Bridge to Open," *Philadelphia Inquirer* (25 May 1957), 15.
[21] The equivalent of approximately $52.7 million in 2022.
[22] Frederick T. Thorpe, Chief Engineer and Surveyor, Philadelphia Department of Streets, to Editor of Philadelphia Inquirer, 25 Jul 1957; "New Spring Garden St.," *Philadelphia Inquirer* (4 Mar 1959), 24; "Art Museum Traffic Tunnel," *Philadelphia Inquirer* (18 Aug 1959), 20; Frank Rosen, "Converted Trolley Tunnel to Open," *Philadelphia Inquirer* (11 Oct 1959), 27, 58; "Two Bridges In Place of One," *Philadelphia Inquirer* (11 Nov 1961), 8; "Art Museum Traffic Maze," *Philadelphia Inquirer* (28 Feb 1962), 38.
[23] Today called Martin Luther King, Jr. Drive.
[24] "Bridging the Schuylkill," *Philadelphia Inquirer* (5 Jun 1966), 27.

Originally expected to cost $2 million and be completed in 1962,[25] the dual bridge complex eventually cost $3.2 million.[26] Although the project was managed by the City of Philadelphia, the Pennsylvania Department of Highways contributed $1.5 million.[27] Advanced construction activities got under way in the summer of 1964. Demolition of the old bridge took two months and concluded in June of 1965. By September of the same year the lower of the two spans, the West River Drive Bridge, was under construction. Before the lower bridge was completed, construction on the higher-level Spring Garden Street Bridge got under way.[28]

The West River Drive Bridge opened on 8 Dec 1965[29] and the Spring Garden Street Bridge opened at 7:30 in the evening of Wednesday 9 Jun 1966.[30] The latter featured a ribbon-cutting by Mayor Tate and Streets Commissioner David M. Smallwood. After a short motorcade proceeded over the upper level, a police officer cleared the roadway of the approximately one hundred observers and announced, "We're open for business!" The driver of the first unofficial vehicle to cross the bridge leaned out of his window and inquired of the officer, "Will this take me to Market Street?" The officer shrugged and the crowd groaned as life in Philadelphia went on as before.[31]

It was undeniable, however, that the Spring Garden Street and West River Drive Bridges

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[25] "New Spring Garden St.," *Philadelphia Inquirer* (4 Mar 1959), 24.
[26] The equivalent of approximately $29.2 million in 2022.The total cost may have included the other improvements (widening of Spring Garden Street, construction of a new Eakins Oval, and reconfiguration of the roadways on the west side of the Art Museum). See "Converted Trolley Tunnel to Open," *Philadelphia Inquirer* (11 Oct 1959), 27, 58.
[27] "Council to Get Bill Providing 2 New Spans at Art Museum," *Philadelphia Inquirer* (6 Nov 1962), 33.
[28] "Test Pilings Are Placed [photograph]," *Philadelphia Inquirer* (28 Aug 1964), 31; "To Detour a Traffic Jam," *Philadelphia Inquirer* (17 Mar 1965), 26; "Bridge Will Close," *Philadelphia Inquirer* (4 Apr 1965), 68; "Spring Garden Bridge Closes," *Philadelphia Inquirer* (5 Apr 1965), 8; "Work Progresses On Bridge [photograph]," *Philadelphia Inquirer* (25 Sep 1965), 35; "New Bridge Open to Traffic," *Philadelphia Inquirer* (8 Dec 1965), 44; "New Spring Garden Street Bridge [photograph]," *Inquirer* (24 Apr 1966), 288f; "New Spring Garden Street Bridge [photograph]," *Inquirer* (1 May 1966), 33; "Bridging the Schuylkill," *Philadelphia Inquirer* (5 Jun 1966), 27.
[29] "New Bridge Open to Traffic," *Philadelphia Inquirer* (8 Dec 1965), 44.
[30] "New Bridge Is Opened," *Philadelphia Daily News* (9 Jun 1966), 3.
[31] Jack Lloyd, "'Where To?' Asks First User of New Bridge," *Philadelphia Inquirer* (9 Jun 1966), 39.

were together a sleek new addition to the landscape surrounding Fairmount. The aqua-painted horizontal steel girders of both bridges curved gracefully while the scissors-like offset of the two spans added an angular visual appeal.[32]

One bad idea boomeranged back but in a slightly different location. In 1967 Mayor Tate resurrected the idea of a heliport near Fairmount, this time on so-called "surplus" park land on the south side of the Benjamin Franklin Parkway. The mayor thought the lack of such a facility was "embarrassing" to the city. The Fairmount Park Commissioners weren't opposed to a heliport, but rejected the location out of hand. "The heliport, with all its attendant noise, is not consistent with the beauty of Fairmount Park," Commissioner Isaac D. Levy stated. "I don't see why we should put it in front of the Art Museum." Commissioner Vincent P. McDevitt agreed. "We've been turning it down to my knowledge for at least fifteen years. It's a question of preserving the park." The members of the Commission were not very keen on the mayor referring to any park land as surplus either. Fairmount Park Commission President Fredric R. Mann, however, agreed to appoint a committee to study the issue, but a heliport was never built anywhere near Fairmount.[33]

Another idea was applauded but took a long time to be realized. Later in 1967 the Fairmount Park Commission approved plans for a linear park along the east bank of the Schuylkill River from Fairmount down to South Street. The project included a landscaped promenade trail along its entire length and a community park and garden at its southern end. It was expected to cost $6.6 million[34] and be completed in time for the Bicentennial in 1976,[35] but

[32] The two bridges, both of which still stand, appear to be attached in some way but they are in fact two separate structures, not connected above their foundations.
[33] "Board to Study Heliport Near Art Museum," *Evening Bulletin* (9 Feb 1967), courtesy Special Collections Research Center, Temple University Libraries.
[34] The equivalent of approximately $58.5 million in 2022.
[35] Nicholas W. Stroh, "Park Approved for east Bank of Schuylkill," *Evening Bulletin* (12 October 1967), courtesy Special Collections Research Center, Temple University Libraries.

was not constructed until decades later.[36]

One bright spot on Fairmount's grounds was the Azalea Garden behind the Art Museum along East River Drive. Created in 1952 with the help of the Pennsylvania Horticultural Society, its popularity had increased even as other parts of the grounds saw fewer visitors than ever. An annual azalea festival was held every May beginning in 1969.[37]

A few months after Susan Myers traveled with her husband down the Schuylkill Expressway, an all-female volunteer organization called the Junior League of Philadelphia was casting about for a project with which it could contribute to the upcoming bicentennial celebration in the city. The local branch of the international Junior League was begun in 1912 and continues today to promote volunteerism and leadership development among women.[38] Susan Myers had for years been a member of Junior League chapters wherever she and her husband had lived and had been involved in the Philadelphia organization since they moved to Philadelphia in late 1970.[39]

Susan Myers had just the project in mind. She convinced the Junior League of Philadelphia[40] to hold its annual autumn meeting for 1974 in the central room of the Engine House. In addition to the usual organizational business, Myers arranged for archeologist John L. Cotter[41] to make a presentation on the importance of preserving the physical remnants of the

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[36] "About FSRP," *Friends of Schuylkill River Park* (2020), <www.fsrp.org/about>, accessed 31 Mar 2022.

[37] "Park Azaleas Say 'Welcome' to May Visitors," *Evening Bulletin* (8 May 1960), courtesy Special Collections Research Center, Temple University Libraries; "Park Azalea Festival to Open Sunday," *Evening Bulletin* (1 May 1970), courtesy Special Collections Research Center, Temple University Libraries. Keeping the four-acre garden well-groomed wasn't cheap. By the mid-1990s, maintenance costs ran to $35,000 annually, with additional work each month by a volunteer group. See Ron Avery, "Museum's Landscape Not Worth Painting," *Philadelphia Daily News* (15 Aug 1997), 8.

[38] The Junior League of Philadelphia is a 501(c)(3) nonprofit organization. See *The Junior League of Philadelphia* (2015, 2021), <www.jlphiladelphia.org>, accessed 27 Jan 2021.

[39] Junior League of Philadelphia, *1970 Annual Report* (Summer 1970), handwritten annotations at 112, 164.

[40] Hereafter the "Junior League."

[41] John L. Cotter (1911–1999) was a prominent archeologist who made major contributions to the field of archeology over his lifetime. See "Death of John Cotter, Noted Archaeologist," *Almanac,* Vol. 45. No. 20

past, from documents to buildings—a concept Cotter called "Above Ground Archeology," the subject of a pamphlet by the same name which he had recently published in connection with his work for the American Revolution Bicentennial Commission.[42] A film about the Fairmount Water Works was shown and the meeting was followed by a catered luncheon on the Engine House deck overlooking the Schuylkill River.[43] The setting and presentations must have made a deep impression on the members because at their next general members meeting, in April 1975, they voted to take on the Fairmount Water Works as a special project.[44] The organization committed to assist in the restoration of the Fairmount Water Works, with the goals of publicizing the need to preserve the building complex, convincing public officials of the importance of the site, working with the Fairmount Park Commission to determine future use, and obtaining estimates for necessary repairs[45]—all starting with a budget of $6,000 of "seed money"[46] from the volunteer organization's own funds.[47]

The Junior League didn't waste time. By the fall of 1975, a "Fairmount Waterworks Restoration Committee" of 35, chaired by Myers,[48] was busy conducting historical research, meeting with numerous experts in the field of historical restoration and preservation, considering

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(University of Pennsylvania, 16 Feb 1999); Mark Rose, "John L. Cotter: In Memoriam, A Life Dedicated to Archeology," *Archeology* (Archeological Institute of America, 22 Feb 1999), <https://archive.archeology.org/online/features/cotter/lifehtml>, accessed 6 Apr 2022.

[42] John L. Cotter, *Above Ground Archeology* (American Revolution Bicentennial Commission: 1974).

[43] Junior League of Philadelphia, *1975 Annual Report* (Summer 1975), 44.

[44] Junior League of Philadelphia, *1975 Annual Report* (Summer 1975), 45.

[45] Junior League of Philadelphia, *1976 Annual Report* (Summer 1976), C-6; Fairmount Park Commission, *1986–87 Annual Report* (18 Nov 1988), 18; Fairmount Park Commission, *The Water Works, Philadelphia* (Philadelphia: 8 Sep 2001). Over the succeeding fifteen years, the Junior League, and later the Water Works Restoration Committee, would raise over $7.5 million for the stabilization of the decks and river-level structures. This initial work was completed in 1990.

[46] The equivalent of approximately $33,000 in 2022.

[47] Junior League of Philadelphia, *1975 Annual Report* (Summer 1975), 45; "Preservation: Something Worth Saving," *Philadelphia Inquirer* (13 Dec 1976), courtesy Special Collections Research Center, Temple University Libraries.

[48] Throughout this period, the Junior League followed traditional practice in referring to their married members by their married names. Thus "Mrs. George C. Myers" for Susan Myers. See for example Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17.

various ways the buildings could be put to adaptive reuse, obtaining cost estimates, and exploring fundraising ideas. The committee entertained the Fairmount Park Commissioners at a luncheon prior to the Commission's monthly meeting in October and obtained the organization's permission to begin planning for the restoration of the exterior.[49] In March 1976 it obtained written authorization to raise funds for the purpose.[50] Within three years of its establishment, the committee had more than doubled in size, to 78.[51]

In December 1977 the committee launched its first benefit fundraiser, "A Galaxy of Trees," in the lobby of the Center Square Office Building in center city Philadelphia. The brainchild of Junior League member Hester Pepper,[52] 36 full-size, decorated artificial Christmas trees were donated by businesses and individuals and raffled off, with Fairmount Park Commission President Robert B. Crawford drawing winners. Junior League members crafted additional small trees and ornaments for sale. Individual balusters and columns were also "sold" for $25 and $120 apiece respectively.[53] The event, the first of many,[54] raised $2,600.[55]

Myers and the other members of the Junior League held no illusions regarding the magnitude of the effort before them; they were fully aware that restoring Fairmount would "take

[49] Junior League of Philadelphia, *1976 Annual Report* (Summer 1976), C-20.
[50] Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17; "Preservation: Something Worth Saving," *Philadelphia Inquirer* (13 Dec 1976), courtesy Special Collections Research Center, Temple University Libraries.
[51] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-20.
[52] Sally A. Downey, "Obituary: Hester Laning Pepper, 95; Started Blind-Artist Group," *Philadelphia Inquirer* (17 May 2002), B10.
[53] The equivalent of approximately $122 and $586 in 2022.
[54] The Junior League would sponsor an annual Galaxy of Trees fundraiser for many years before turning it over to the Preservation Coalition of Greater Philadelphia. See Edgar Williams, "A 'Galaxy' of Christmas Trees," *Philadelphia Inquirer* (11 Dec 1984), 22; Debra Nussbaum, "Mansions In the Mode of the 1700s," *Philadelphia Inquirer* (30 Nov 1990), 106.
[55] Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17; "The Junior League," *Philadelphia Inquirer* (11 Dec 1976), 4; "Preservation: Something Worth Saving," *Philadelphia Inquirer* (13 Dec 1976), courtesy Special Collections Research Center, Temple University Libraries; Ruth Seltzer, "Galleria and Galaxy," *Philadelphia Inquirer* (16 Dec 1976), 38. The amount is the equivalent of approximately $12,700 in 2022.

millions."[56] In April 1977, the Junior League devoted another $10,000 of its own money[57] to the project, bringing the total to $16,000,[58] for the purposes of immediate stabilization.[59] An additional $10,000, to be used for matching funds, was approved for the next fiscal year.[60]

Two months later the organization organized its second fundraiser, "Victorian Sunday." Held at the Water Works, the event featured antique cars and bicycles, the Police and Fireman's Band, a horse-drawn police wagon, a regatta above the Fairmount Dam, a fireboat water salute to Fairmount from below the dam, a $13-a-plate buffet,[61] and Junior League members wearing period dress.[62] The popular fundraiser became an annual event for a number of years.[63]

It is difficult to exaggerate the importance of the early work of Myers and the members of the Junior League to the eventual restoration of the Fairmount Water Works. Although the amounts raised by the early fundraising events were relatively small, one of the major goals of the Fairmount Waterworks Restoration Committee was to set the urgency of Fairmount's preservation before both power brokers and ordinary members of the public alike. This it did to great effect, not the least because of Susan Myers' persistence.

Myers spoke before countless civic and neighborhood groups. She was determined,

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[56] Nessa Forman, "Building Will Be Restored: Junior League Seeks Aid for Waterworks," *Evening Bulleting* (1 Mar 1977), courtesy Special Collections Research Center, Temple University Libraries. Henry Magaziner, architect for the Bicentennial Planning Group, estimated at the time that it would take "in excess of $2.25 million" to restore Fairmount and create a restaurant and museum. Indeed, it would take many times that amount before long.
[57] The equivalent of approximately $48,900 in 2022.
[58] The equivalent of approximately $78,200 in 2022.
[59] "Preservation: Something Worth Saving," *Philadelphia Inquirer* (13 Dec 1976), courtesy Special Collections Research Center, Temple University Libraries.
[60] Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17.
[61] The equivalent of approximately $65 in 2022.
[62] Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17; "Vanity Fair," *Philadelphia Daily News* (18 Jun 1977), 2; Tom Masland, "At the Water Works, A Party and a Cause," *Philadelphia Inquirer* (20 Jun 1977), 1-Bf.
[63] "Fun At the Water Works," *Philadelphia Inquirer* (10 Jun 1978), 10; "Entertainment Notes," *Philadelphia Daily News* (10 Jun 1978), 18; "Monkey Shines and Sunshine Prevail," *Philadelphia Inquirer* (12 Jun 1978), 1; Robert Strauss, "Victorian Sunday Recaptures Gay 90s Era," *Philadelphia Daily News* (12 Jun 1978), 10; Ann Kolson, "A Stroll Through the Past At the Waterworks," *Philadelphia Inquirer* (18 May 1979), 69; Mary Bishop, "Oh, Down By the Old Mill Stream," *Philadelphia Inquirer* (21 May 1979), 2. The latter article features a photograph of a fireboat generating a multi-stream water salute.

relentless, and well-prepared. “Dedicated and thorough,” one of her Junior League colleagues described her; “a driven woman, an indomitable force.”[64] She was welcomed into the offices of public officials throughout the city, as well as the region and the state.[65] She fearlessly spoke to anyone she could, high or low.

In meeting after meeting, Myers was famous for pulling out of her purse a restaurant placemat she had picked up somewhere along the way that depicted the Fairmount Water Works and other Philadelphia landmarks. Eventually she had it laminated. If so humble a thing as this could acknowledge the importance of Fairmount, she would remonstrate, why couldn’t this city do the same? Her point was clear—something so recognizable and precious to Philadelphia should not be allowed to disappear.

The Fairmount Waterworks Restoration Committee depended greatly upon the volunteer support of Junior League members. They organized fundraisers, mounted letter-writing campaigns, and met with elected and administrative officials. They also applied for grants from various sources, which was important in broadening the scope of the financial contributions. In this way the group was able to leverage its influence far beyond what might have been expected. As Bill Marrazzo, Philadelphia Water Department Commissioner from 1980 to 1988, would later put it:

> They were well-versed, well-informed, enthusiastic, and insistent. They knew they had a good basis for their adopting the Fairmount Water Works for their philanthropy. I felt compelled to respect it and pay attention to it.[66]

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[64] Marilyn Sprague, former colleague of Susan Myers, Junior League of Philadelphia, telephone interview with author-editor, 16 Oct 2021.
[65] “Susan Wiener Myers,” *Monaghan Funeral Home* (unknown date), <http://www.monaghanfuneralhome.com/obituaries/print?o_id=4856781>, accessed 16 Aug 2021.
[66] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.

By the early 1990s, as the involvement of other organizations increased, the Junior League's involvement wound down. Susan Myers' Fairmount Waterworks Restoration Committee had shown the way, but it was never meant to last forever. Myers was now in her seventies and her health began to decline. The Junior League handed the baton to other organizations. The funds that remained at that time, approximately $35,000,[67] were transferred to the Fairmount Park Historic Preservation Trust,[68] a separate organization from the Fairmount Park Commission.[69]

In part because of the activity of the Junior League, the Fairmount Water Works began to attract recognition as a significant historical site. In June 1975 it was declared a National Historic Civil Engineering Landmark by the American Society of Civil Engineers which presented a commemorative plaque to the city.[70] The following summer the U.S. Secretary of the Interior designated it a National Historic Landmark.[71] In March 1977 the complex was declared a National Historic Engineering Landmark by the American Society of Mechanical Engineers.[72] The next June the American Water Works Foundation presented to the City a bronze plaque

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[67] The equivalent of approximately $75,000 in 2022.

[68] "Susan Wiener Myers," *Times Leader* (21 Jan 2009), <www.legacy.com/us/obituaries/timesleader/name/susan-myers-obituary?pid=123077597>, accessed 31 Aug 2021; "Susan Wiener Myers," *Oliver H. Bair Funeral Home* (unknown date), <www.philadelphiafuneralcare.com/obituary/4856781>, accessed 31 Aug 2021. The second obituary mentions $10,000 for restoration of the eagle atop the Eagle Pavilion and $35,000 for restoration of the Graff Memorial.

[69] Although the Junior League of Philadelphia no longer maintains a standing committee dedicated to Fairmount's preservation, it does value its legacy of involvement and still contributes from time to time—$10,000 in 2021, for example. See Marilyn Sprague, sustainer member, Junior League of Philadelphia, former Secretary, Fund for the Water Works, telephone interview with author-editor, 16 Aug 2021; personal interview, 3 Oct 2021.

[70] Fairmount Park Commission, *1974–75 Annual Report* (5 Jan 1976); Nadine Cohodas, "Honoring Water Works," *Philadelphia Inquirer* (18 Jun 1975), 14; "Engineers Hail Fairmount Water Works," *Philadelphia Daily News* (18 Jun 1975), 28.

[71] "Living Places," *Index of National Landmark and National Historic Register Properties* (The Gombach Group, 1997–2016); <http://www.livingplaces.com/nationalregisterindex.html>, accessed 26 Aug 2016; Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17.

[72] *Fairmount Water Works, 1815–1911: A National Historic Mechanical Engineering Landmark*, (American Society of Mechanical Engineers, 29 Mar 1977); Fairmount Park Commission, *1977–78 Annual Report* (30 Sep 1978), 8. The Society donated a plaque. See Junior League of Philadelphia, *1977 Annual Report* (Summer 1977), C-17.

identifying Fairmount an American Water Landmark.[73] No funds came with any of this recognition, but the designation did help in raising funds from public and private sources alike.

On Friday 10 Feb 1978, Susan Myers arranged for a special program at the Franklin Institute for officials of the U.S. Department of the Interior and various agencies of the City of Philadelphia, including the Water Department and Fairmount Park Commission. Dr. Michael McMahon, Director of Historical Programs at the Franklin Institute, gave an audio-visual presentation on the history and importance of Fairmount and exhibited stereographs, building plans, and original drawings by Frederick Graff. The Junior League hosted the group for lunch at a nearby restaurant and provided a hard-hat tour of the Fairmount Water Works in the afternoon.[74]

A meeting later that day with Water Department Deputy Commissioner Kenneth Zitomer resulted in the Deputy Commissioner convincing officials at the Interior Department's National Park Service to make the Fairmount Water Works one of the summer projects for its Historic American Engineering Record (HAER) program[75] that year. The federal agency assigned a team of three architects, two engineers, two historians, and two planners to document Fairmount's history and physical aspect. One of fifteen HAER teams created that year, it was the largest to date.[76] The team began work on 12 Jun 1978 and finished by the end of the summer. The Water Department contributed $20,000 in funding for the project,[77] while the Interior Department

[73] "Fun At the Water Works," *Philadelphia Inquirer* (10 Jun 1978), 10.
[74] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19.
[75] The Historic American Engineering Record was created in 1969 by the National Park Service, Library of Congress, and the American Society of Civil Engineers. Later contributions were made y four other engineering societies. See Historic American Engineering Record [HAER], *Fairmount Water Works, 1812–1911* (Washington, D.C.: National Park Service, U.S. Department of the Interior, 1978).
[76] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-20.
[77] The equivalent of approximately $90,000 in 2022.

contributed $7,000.[78] All of the photographs, technical drawings, and historical reports that the project generated were deposited in the Library of Congress and today are available online.[79] The project and resulting documentation became one of the key foundational steps in preparation for virtually all of the subsequent restoration efforts at Fairmount.

On 31 Mar 1978 the Junior League of Philadelphia made its first monetary contribution to the restoration of the Fairmount Water Works when in a ceremony in the Mayor's Reception Room in City Hall the organization's president presented a check for $24,000[80] to Water Department Commissioner Guarino "for immediate stabilization repairs to the roofs, etc. at the Waterworks." Two thirds came from the Junior League's Community Trust Account and one third had been raised by the Galaxy of Trees and Victorian Sunday events.[81] The City of Philadelphia turned around and awarded a $20,000 contract[82] to Kulzer Roofing[83] in June 1979 to stabilize and waterproof the roof of the Engine House. Sixteen thousand dollars[84] came from a Junior League donation and $4,000[85] was contributed by the Philadelphia Water Department.[86] This was the first substantial work to raise Fairmount from the dead.

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[78] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19. The amount is the equivalent of approximately $32,000 in 2022.
[79] Historic American Engineering Record [HAER], *Fairmount Water Works, 1812–1911* (Washington, D.C.: National Park Service, U.S. Department of the Interior, 1978). Often referred to as the "HAER Report," it maya be found online at <http://hdl.loc.gov/loc.pnp/pp.print>. Incidentally, Jane Mork Gibson was one of the two historians on the team and wrote the report's historical narrative, a substantial contribution in its own right.
[80] The equivalent of approximately $109,000 in 2022.
[81] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19. The Galaxy of Trees became a popular and highly anticipated annal event. The Junior League of Philadelphia eventually handed off responsibility for the recurring fundraiser to others. The Preservation Coalition of Greater Philadelphia, for example, sponsored the Christmastime fundraiser in December 1991. See Fairmount Park Commission, *1991–92 Annual Report* (Jun 1992), 6.
[82] The equivalent of approximately $82,000 in 2022.
[83] Kulzer Roofing is a local roofing company begun in 1959. Founder William C. Kulzer died in 2010 at the age of 95. See "Kulzer Roofing Inc.," *OpenCorporates* (12 Feb 2021), <https://opencorporates.com/companies/us_pa/193795>, accessed 13 Apr 2022; "William C. Kulzer," *Philadelphia Inquirer* (8 Jan 2010), <www.legacy.com/us/obituaries/inquirer/name/william-kulzer-obituary?id=10306422>, accessed 13 Apr 2022.
[84] The equivalent of approximately $65,000 in 2022.
[85] The equivalent of approximately $16,000 in 2022.
[86] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-20.

As the Junior League was making its milestone contribution, in early 1978 Water Commissioner Carmen F. Guarino went public with a proposal to construct a new Water Department headquarters building on the river at Fairmount between the Mound Dam and the *Fountain of the Seahorses,* the location of the outer Forebay.[87] Estimated to cost approximately $5 million,[88] the 50,000-square-foot building would be designed with a low profile in order to blend in with its surroundings.[89]

Guarino recognized that no matter how much money was spent on restoration and rehabilitation, if Fairmount were not activated and occupied it would all be lost to vandalism and neglect. Believing the eventual consolidation of all department offices in the vicinity of Fairmount offered a potential solution, he asked City Council to include funds for planning in its next capital budget and funds for construction in the budget for the fiscal year after that. City Planning Commission Executive Director John Mitkus added that the project would be paid for by revenue bonds—in other words, the money would be borrowed and paid back out of Water Department revenues. The department would also apply for a $100,000 grant[90] from the Pennsylvania Museum and Historical Commission to partially pay for renovation of the Water Works buildings.[91] Two weeks later, however, Mayor Frank L. Rizzo announced that although the Water Department would continue to pursue improvements of the Water Works complex, public opposition had forced him to cancel any plans for an office building on park land near Fairmount.[92]

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[87] Kenneth J. Zitomer, Deputy Commissioner, to Carmen F. Guarino, Commissioner, Philadelphia Water Department (18 Jul 1977); memorandum and plat plan.
[88] The equivalent of approximately $22.7 million in 2022.
[89] Jill Porter, "City Mulls Water Works Restoration," *Philadelphia Daily News* (4 Mar 1978), 9.
[90] The equivalent of approximately $450,000 in 2022.
[91] J. D. McCaffery, "Water Department Proposes Offices By Schuylkill," *Evening Bulletin* (1 Mar 1978), courtesy Special Collections Research Center, Temple University Libraries; Jill Porter, "City Mulls Water Works Restoration," *Philadelphia Daily News* (4 Mar 1978), 9.
[92] "It's Not In the (Water) Works," *Philadelphia Inquirer* (16 Mar 1978), 19.

Public perception of Fairmount continued to grow. In May 1978, John Milner, a prominent restoration architect and Adjunct Professor of Architecture at the University of Pennsylvania's School of Design,[93] opened an exhibit at the university in which he presented drawings by ten of his graduate architecture students depicting various possible adaptive reuses for Fairmount. Among the suggested uses were a ballet theatre, marina, horticultural center, and sports arena. While the feasibility of some of the proposals may have been debatable, the exhibit served to promote Fairmount's potential in the public imagination.[94]

The next month City Council included $1 million[95] in its capital budget for restoration work at Fairmount, as requested by Water Commissioner Guarino. The money became available during the following fiscal year, which started on the first of July.[96]

Nudge by nudge, there began to be a gradual awakening to the necessity to restore Fairmount. Perhaps the Junior League's most successful vehicle for improving public awareness at this time was the Water Works Café.

Since 1835, some sort of food—often including ice cream[97]—was sold in the Engine House to visitors to the Fairmount Water Works.[98] This amenity was closed when the Bureau of Water shut Fairmount down as a water pumping facility. Although there was never a food concession in the Aquarium, ever since the Engine House had closed to the public in 1949 it was recognized that it would be a desirable location for some sort of refreshment service. A food and

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[93] "John Milner, FAIA, Principal," *John Milner Architects* (2022), <https://johnmilnerarchitects.com/profile/people/john-milner>, accessed 13 Apr 2022.
[94] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19.
[95] The equivalent of approximately $4.5 million in 2022.
[96] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19f; Nessa Forman, "A $7,500 Fiberglas Repro," *Evening Bulletin* (29 Apr 1979), courtesy Special Collections Research Center, Temple University Libraries. The City of Philadelphia's municipal fiscal year runs from the beginning of July to the end of June.
[97] "City Items," *North American and United States Gazette*, Issue, 16, Vol. 110 (Philadelphia: Friday, 10 Sep 1847); *Photographic record*, Fairmount Park Historic Resource Archives.
[98] "Sealed Proposals Will Be Received," *Philadelphia Inquirer* (3 May 1867), 7; "Trips Awheel: Where to Go and How to Get There," *Philadelphia Inquirer* (25 Jul 1897), 36.

beverage concession had been planned there as early as 1952, but never came about.[99]

There were always a few, however, who saw the potential. In December of 1959, in what was reputedly the first time since 1880 that the Fairmount Water Works was rented for a private affair, a debutante ball was held for Margaret Van Dyke Trout by her parents. “Can you think of a better place for a Trout to come out?” asked 18-year-old Peggy, as she was known to her friends. Surrounded by undersea-themed decorations, 400 guests mingled and danced in the Engine House, toured the displays below, and dined on the tented and heated deck.[100]

A new dining establishment was finally realized in June of 1977 when the Junior League, in a joint effort with the Fairmount Park Commission and the Philadelphia Water Department,[101] launched the Water Works Café as a means of raising funds for Fairmount’s restoration.[102] Seating customers from eleven o’clock in the morning to six-thirty in the evening, seven days a week, the café offered *al fresco* dining under colorful blue-and-white umbrellas on the riverside deck of the Engine House. Because it was outdoors-only, it was intended to run only until October.[103]

The café had a second purpose—to call attention to Fairmount’s poor condition. Graffiti was mostly left untouched and only a limited spruce-up was made. The desired effect was that people would think, “This is a great place; someone should really fix it up.”[104]

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[99] Fairmount Park Commission, *1952 Annual Report* (Jan 1952), 11f.
[100] “The Philadelphia Scene…” *Philadelphia Inquirer* (13 Dec 1959). The only thing missing were real trout—that species of fish hadn’t been present at the Aquarium since a reintroduction was attempted ten years earlier. Miss Trout married David Llewellyn Van Schaick three years later and died in 2004 at the age of 63. Her husband David died in 2016 at the age of 79. See “David Van Schaick [obituary],” *Main Line Times & Suburban* (11 Aug 2016).
[101] Denise Breslin Kachin, “Lunch by Schuylkill At Water Works Café,” *Evening Bulletin* (2 Aug 1978), 19, 26, courtesy Special Collections Research Center, Temple University Libraries.
[102] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-18; Fairmount Park Commission, *1977–78 Annual Report* (30 Sep 1978), 5f.
[103] Bill Curry, “But Will They Serve Water With Meal?” *Philadelphia Inquirer* (28 Jun 1977), 25.
[104] Clark DeLeon, “On the River: The Graffiti Gourmet,” *Philadelphia Inquirer* (28 Jul 1977), 2.

The café was operated by Linda Snyder (a Junior League member[105]), Sally Rock, and (for the first year) Sara Goegeline,[106] all recent graduates of The Restaurant School.[107] After obtaining clearances from the City of Philadelphia and the Fairmount Park Commission, the three each invested $2,000[108] to cover startup expenses. With money tight, they scrounged for what they could. They purchased major appliances—such as a commercial refrigerator, a freezer, and an ice machine—second-hand. They borrowed canvas folding chairs from the basement storage of the Fairmount Park Commission's Memorial Hall headquarters. Recently utilized at the Playhouse in the Park, only 60 out of the available 500 chairs were useable, and then only after repairs.[109]

The chairs were involved in an incident that pointed up a lack of security.[110] While the three ladies and their staff were busy readying the café for opening day, a group of six teens simply ambled up onto the deck, tossed some of the chairs into the river, and ran off before the astonished workers had hardly a chance to react. Linda Snyder happened to be wearing nautical-style, canvas deck shoes; when the tide began to recede, she waded out into the mud to retrieve the chairs.[111]

The Engine House itself presented its own set of challenges. Building plans were hard to come by. Historic documents were eventually located in the Franklin Institute's rare book

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[105] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19; Denise Breslin Kachin, "Lunch by Schuylkill At Water Works Café," *Evening Bulletin* (2 Aug 1978), 19, 26, courtesy Special Collections Research Center, Temple University Libraries.

[106] Ruth Seltzer, "Outdoor Dining at Water Works," *Philadelphia Inquirer* (28 Jun 1977), 30; "Café to Benefit Old Fairmount Water Works," *Evening Bulletin* (28 Jun 1977), courtesy Special Collections Research Center, Temple University Libraries.

[107] Today called Walnut Hill College. See "About Walnut Hill College," *Walnut Hill College* (2022), <www.walnuthillcollege.edu/about-whc>, accessed 8 Apr 2022.

[108] The equivalent of approximately $9,700 in 2022.

[109] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.

[110] Denise Breslin Kachin, "Lunch by Schuylkill At Water Works Café," *Evening Bulletin* (2 Aug 1978), 19, 26, courtesy Special Collections Research Center, Temple University Libraries.

[111] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.

library.[112]

The surface of the deck was found to be coated with an asphalt treatment that became sticky in the hot sun, so the ladies covered it with plywood topped with used AstroTurf® purchased from John F. Kennedy Stadium in south Philadelphia. The ladies hoped no one would notice a 40-yard-line marker under one of the corner tables.[113]

There was no plumbing where they wanted to create a kitchen. It would have been prohibitively expensive—not to mention historically inappropriate—to cut into the stone masonry walls to run water lines, so they instead set up a kitchen in an area next to the ladies' rest room where they could tap into the plumbing.[114]

With no gas lines and the uncertain safety of running an electric stovetop and oven at the same time as a cooler, freezer, and other appliances on the existing 50-year-old wiring, the trio opted to go with a no-cook menu featuring light fare such as "Danish-style" open-faced sandwiches, salads, and a variety of desserts.[115] Some of the menu items and selected prices included roast beef sandwich with avocado slices, cabbage slaw, cherry tomatoes, and garlic mayonnaise on pumpernickel for $3.25; turkey sandwich with smoked oysters, red onions, and Russian dressing on rye; shrimp and cucumber sandwich with fresh dill mayonnaise; skewered raw vegetables aioli with garlic mayonnaise for $1.50; tabouli salad; and the Water Works Special—cold poached chicken with honey-lemon sour cream sauce, encircled with fresh fruit and berries for $5.50. Dessert included hazelnut cheesecake for $2.00 and chocolate *Pot de*

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[112] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.
[113] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.
[114] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.
[115] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.

Crème.[116] Beverages included sparkling cider and red zinger tea for 75 cents. They did serve water; in addition to any tap water, bottles of Perrier® were offered for a dollar each.[117] The operation had no liquor license, but guests were invited to bring their own wine.[118]

The riverside location, colorful umbrellas, and ramshackle-chic ambience combined to create a certain European vibe.[119] One writer described it as like dining in a Monet painting.[120]

In late summer Elaine Tait, the food and restaurant critic for the *Philadelphia Inquirer* at the time,[121] gave the Water Works Café a good review.[122] Despite vehicle and train noise from the Schuylkill Expressway and railroad across the river and "an occasional whiff of river fragrance that is definitely not Arpege or Chanel No. 5," Tait thought the setting was "architecturally splendid" and the menu "imaginative," especially considering the limitations of the kitchen. She described the patrons around her as "nice, wholesome-looking Main Line matrons, bearded art students, and couples who look like somebody's shabby genteel grandparents" and encouraged her readers to visit and make the "last weeks a smashing sellout."[123]

Operating the café out of the Engine House wasn't easy. "There were lots of times we

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116 Ruth Seltzer, "Outdoor Dining at Water Works," *Philadelphia Inquirer* (28 Jun 1977), 30 Elaine Tait, "Restaurants: Water Works Café," *Philadelphia Inquirer* (28 Aug 1977), 326; "Action Line," *Philadelphia Inquirer* (23 Sep 1977), 17; Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119. The cost of some of the items is not known. The $.75–5.50 spread is the equivalent of $3.67–26.88 in 2022.

117 Andrea Diehl, "The Pleasure of Outdoor Dining," *Philadelphia Daily News* (15 Jul 1977), 31, 34; Elaine Tait, "Restaurants: Water Works Café," *Philadelphia Inquirer* (28 Aug 1977), 326.

118 Ruth Seltzer, "Outdoor Dining at Water Works," *Philadelphia Inquirer* (28 Jun 1977), 30; Andrea Diehl, "The Pleasure of Outdoor Dining," *Philadelphia Daily News* (15 Jul 1977), 31, 34.

119 Clark DeLeon, "On the River: The Graffiti Gourmet," *Philadelphia Inquirer* (28 Jul 1977), 2.

120 Andrea Diehl, "The Pleasure of Outdoor Dining," *Philadelphia Daily News* (15 Jul 1977), 31, 34.

121 Elaine Tait wrote for the *Inquirer* in this capacity for 35 years, until retiring at the end of 1997. See "Tait to Evacuate," *MyCityPaper* (4 Dec 1997), <https://mycitypaper.com/articles/120497/om3.shtml>, accessed 7 Apr 2022.

122 Tait's rating system was explained from time to time in her reviews. See for example Elaine Tait, "Restaurants: Cherrystones," *Philadelphia Inquirer* (15 May 1977), 322. "Elaine Tait's rating system awards from one star for the average restaurant to four for the extraordinary one." Tait awarded two stars to the Water Works Café.

123 Elaine Tait, "Restaurants: Water Works Café," *Philadelphia Inquirer* (28 Aug 1977), 326.

were going to quit," Snyder remarked. "Fortunately, the three of us never wanted to quit at the same time." Despite the challenges, it was declared an "unqualified success" early on.[124] By the time the café closed for the season in mid-October it had racked up an average of 150 meals per day,[125] recovered the operators' initial investments, earned enough to pay the ladies each a modest salary, and generated enough of a profit for the Water Works Restoration Fund[126] that the Junior League opened the café again the following season.[127]

The next year the Water Works Café operated from the Memorial Day weekend[128] until Labor Day. It opened again at eleven in the morning, but this year closed at three in the afternoon.[129] Linda Snyder and Sally Rock—now Sally Killhour, married since the previous season—were back to manage the operation but without Sara Goegeline.[130] The café was as popular and successful as the previous year.

When the Junior League opened the café for the 1979 season, Snyder and Killhour did not return for a third time. Sally Killhour was expecting a baby in the fall and Linda Snyder wanted to open her own restaurant in Bucks County.[131] To replace them, the Junior League brought in the managers of Once Upon a Porch, an ice cream shop in the Head House Square neighborhood. This year the closing bell was adjusted to five in the afternoon.[132]

For the 1980 season, the café was operated by Dennis Dunphy and Tom Reagan, owners

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[124] Clark DeLeon, "On the River: The Graffiti Gourmet," *Philadelphia Inquirer* (28 Jul 1977), 2; Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.
[125] Clark DeLeon, "On the River: The Graffiti Gourmet," *Philadelphia Inquirer* (28 Jul 1977), 2.
[126] Elaine Tait, "Café By Water: The Tribulations of the First Year," *Philadelphia Inquirer* (2 Oct 1977), 119.
[127] Jonathan Takiff, "Way Station," *Philadelphia Daily News* (26 May 1978), 30.
[128] Junior League of Philadelphia, *1978 Annual Report* (Summer 1978), C-19.
[129] "Dine Alfresco [*sic*]," *Philadelphia Inquirer* (26 May 1978), 52.
[130] Denise Breslin Kachin, "Lunch by Schuylkill At Water Works Café," *Evening Bulletin* (2 Aug 1978), 19, 26, courtesy Special Collections Research Center, Temple University Libraries.
[131] Denise Breslin Kachin, "Lunch by Schuylkill At Water Works Café," *Evening Bulletin* (2 Aug 1978), 19, 26, courtesy Special Collections Research Center, Temple University Libraries.
[132] "Water Works Café," Evening Bulletin (2 Aug 1979), courtesy Special Collections Research Center, Temple University Libraries.

of the Down Under restaurant in Philadelphia. This season the closing time was pushed back to nine o'clock in the evening. A special Sunday brunch featured live music. An onsite Artist's Equity open-air gallery provided local color and an additional stream of fundraising potential.[133]

In the fall of 1980, the café did not close as in past seasons, but continued to operate through the winter. Coordinating with the Fairmount Park Commission, Dunphy and Reagan made extensive repairs to the electrical and plumbing systems in the Engine House to allow for indoor dining.[134]

Monday nights now saw a regular schedule featuring the Phil Giordano Jazz Orchestra playing from nine to midnight.[135] A variety of jazz performers, some of whom were sponsored by the Jazz Society of Philadelphia, played on Friday evenings.[136] Jazz continued to be featured on certain evenings throughout 1981.[137]

Ahead of the summer of 1982, prospects for the continued success of the café were brighter than ever. Positive word of mouth had continued to build over the years. The evening music program continued over its second winter and attracted a broader set of customers. Most tantalizing, however, the café was in the process of obtaining its long-anticipated liquor license.[138] Up to now, the establishment had been strictly BYOB.[139]

Just as the Water Works Café seemed set to build even further on its success, a fire broke

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[133] Frank Dougherty, "Water Works Café," *Philadelphia Daily News* (17 Jun 1980), 12; "The New Fairmount Water Works Café," *Evening Bulletin* (2 Jul 1980), courtesy Special Collections Research Center, Temple University Libraries.

[134] Junior League of Philadelphia, *1981 Annual Report* (Summer 1981), D-16.

[135] "Jazz: The Water Works Café," *Philadelphia Daily News* (30 Jan 1981), 41; Jonathan Takiff, "Around the Town," *Philadelphia Daily News* (20 Mar 1981), 31. Over forty years later, Phil Giordano still performs with his jazz orchestra. See "Phil Giordano," *All About Jazz* (2022), <www.allaboutjazz.com/musicians/phil-giordano>, accessed 11 Apr 2022.

[136] For example "Jazz Violinist John Blake," *Philadelphia Inquirer* (24 May 1981), 125.

[137] Elaine Tait, "Come Summer, The 'In' Place to Dine is Outdoors," *Philadelphia Inquirer* (7 Jun 1981), 227, 234; "Jazz: Water Works Café," *Philadelphia Daily News* (26 Jun 1981), 48; "It's Jazz Tonight," *Philadelphia Inquirer* (29 Jan 1982), 60; Nels Nelson, "Jazz," *Philadelphia Daily News* (29 Jan 1982), 37.

[138] John Corr, "Coming" You and the Night and the Guffaws," *Philadelphia Inquirer* (4 Mar 1982), 65.

[139] Elaine Tait, "Come Summer, The 'In' Place to Dine is Outdoors," *Philadelphia Inquirer* (7 Jun 1981), 227, 234.

out in the Engine House during the wee hours on Saturday 1 May. It was reported at 38 minutes after one in the morning; the response went to two alarms before the fire was brought under control a little over forty minutes later. Although the blaze itself was confined to the second floor of the Engine House, the cost of the clean-up of the smoke and water damage was far beyond the financial capability of the café operators.[140] Even had they been able to afford it, the red tape involved because of the historic nature of the building meant that they couldn't repair it themselves if they had wanted. The café did not open for the 1982 season and never opened again afterward. The jazz program was dead as well.

The cause of the fire was never pinned down, but vandalism had been a growing problem.[141] An arson fire which gutted the Watering Committee Building the previous year[142] was an ominous sign of potential disaster if Fairmount weren't properly and thoroughly cared for.

A more durable, if less visible improvement took shape during this time. A fish ladder was completed in 1979 at the western end of Fairmount Dam. Its purpose was to allow migratory fish to pass around the obstacle presented by the structure.

There are two types of migratory fish. "Catadromous" species live most of their lives in rivers and streams and migrate to the ocean to breed. The North American eel is an example. "Anadromous" species are the reverse; they live most of their lives in the ocean but travel up rivers and streams in order to spawn. Salmon is a well-known example of this type.

There are no salmon in the Philadelphia area, but there are shad, herring, bass, eels, and

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[140] Thomas J. Gibbons, Jr., and L. Stuart Ditzen, "Waterworks Damaged in 2-Alarm Fire," *Philadelphia Inquirer* (2 May 1982), 1; "Waterworks Building Hit By Blaze," *Philadelphia Daily News* (3 May 1982), 17. A photograph accompanying the *Inquirer* article shows smoke soot above nearly every visible window on the second and roof truss levels of the Engine House.
[141] Thomas J. Gibbons, Jr., and L. Stuart Ditzen, "Waterworks Damaged in 2-Alarm Fire," *Philadelphia Inquirer* (2 May 1982), 1; "Waterworks Building Hit By Blaze," *Philadelphia Daily News* (3 May 1982), 17.
[142] Thomas Hine, "Water Power Can Pay to Rescue a Landmark," *Philadelphia Inquirer* (1 Nov 1981), 27, 30.

other species that need to swim upstream in order to breed or return from breeding. Since Fairmount Dam was constructed in 1822, migratory fish had been blocked from traveling any further upstream. American shad, as an example, breed in freshwater spawning grounds. They were once so plentiful that the species had supported an entire fishing industry in the local area. By the middle of the twentieth century, however, dams and pollution had combined to cause the disappearance of shad and other migratory fish in the Schuylkill River above Fairmount.

The river was becoming cleaner, but the dam was still there. Shad and other migratory species in the region may be strong swimmers but, unlike salmon, they can't jump. A fish ladder is a series of pools, or cells, connected by narrow vertical slots that allow water to gradually step down around a dam and fish to gradually step up. This allows migrating fish to indirectly bypass the vertical height of a dam that would be impossible for them to do directly in one jump.

Construction on the Fairmount Fish Ladder was begun on 7 Nov 1977[143] and completed on 2 Apr 1979,[144] taking longer than expected due to unexpectedly hard rock at the site on the western end of the dam.[145] It was designed by the Pennsylvania Fish & Boat Commission at a cost of a little over $20,000.[146] The total construction cost was $530,000,[147] with the City of Philadelphia contributing $46,000[148] and the federal government making up the balance.[149] The funding had been arranged by the Wilderness Club of Philadelphia.[150] Dedication took place on 8

[143] "Fish Ladder Construction to Begin Monday," *Philadelphia Inquirer* (4 Nov 1977), 21.
[144] Donald Kimelman, "Where Are You, O Shad?" *Philadelphia Inquirer* (19 May 1979), 35.
[145] Jim Bashline, "Winter Moved Back Finish Date for Fish Ladder at Fairmount Dam," *Philadelphia Inquirer* (25 Apr 1978), 35.
[146] The equivalent of approximately $98,000 in 2022.
[147] The equivalent of approximately $2.1 million in 2022.
[148] The equivalent of approximately $188,000 in 2022.
[149] "Fish Ladder Construction to Begin Monday," *Philadelphia Inquirer* (4 Nov 1977), 21; Donald Kimelman, "Where Are You, O Shad?" *Philadelphia Inquirer* (19 May 1979), 35.
[150] Ruth Seltzer, "Wilderness Club: Support for a 'Fish Ladder,'" *Philadelphia Inquirer* (1 May 1977), 150; Sandy Bauers, "Release of Fish Spawns Hope for Shad's Return to Schuylkill," *Philadelphia Inquirer* (5 Jun 2001), 71.

May 1979. Its 140-foot-long water course[151] was the first fish ladder on the Schuylkill River, the first of its kind, in fact, in Pennsylvania.[152]

A portion of the riverside wall of the Schuylkill Navigation's lock system, used as a retaining wall for West River Drive in the 1950s, was reused for the outer wall of the fish ladder. Its large stone blocks can still be seen from the Fairmount Water Works across the river.

Two years later, a temporary interpretive exhibit was set up at the Philadelphia Zoo, linked to a closed-circuit television feed from a viewing window in the fish ladder. The exhibit cost approximately $25,000[153] and was funded by numerous small donations from individuals, foundations, and corporations, including the Philadelphia Foundation, Morton A. Krause, the Philadelphia Electric Company, SmithKline Corporation, the Blanche G. Whitecar Foundation, the Wyomissing Foundation, and (fittingly) the Penn Fishing Tackle Manufacturing Company.[154] Among the species observed on the video link passing through the fish ladder were American shad, smallmouth and largemouth bass, and walleye.[155]

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If the Fairmount Water Works was to see any kind of meaningful and long-lasting restoration, large amounts of money would need to be obtained from numerous sources. It may be useful at this point to untangle the sometimes confusing ways in which the restoration was funded over the years.

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[151] Donald Kimelman, "Where Are You, O Shad?" *Philadelphia Inquirer* (19 May 1979), 35.
[152] "Where Are You, O Shad?" *Philadelphia Inquirer* (19 May 1979), 35.
[153] The equivalent of approximately $81,500 in 2022.
[154] Edgar Williams, "An Up-Scale Exhibit Opens at Zoo," *Philadelphia Inquirer* (12 May 1981), 33f.
[155] Ben Callaway, "Shad Appearing in the Schuylkill," *Philadelphia Inquirer* (24 May 1981), 98.

Since 1975 the Junior League had been raising money from various sources, mostly individuals, by means of popular events and activities. If the group had built up a pot of money and simply gave it to the City of Philadelphia, however, it likely would have been lost in the City's general fund. Even sequestered funds are notoriously subject to diversion due to the vagaries and vicissitudes of politics. This isn't unique to Philadelphia, of course; it is true for any government, at any level, anywhere. When a charitable organization receives contributions, however, it is generally legally obligated to dedicate those funds as the donor intended.

Add to this the idea of dovetailing the operation of a public entity (the City of Philadelphia, say, or the Fairmount Park Commission) with that of a private establishment (any nonprofit organization) and the process quickly becomes complex, the uncertainties numerous. Who decides spending priorities, for exmple? Who determines the scope of work? How are contractors selected and who pays them? How are funds transferred? Who is obligated to cover exposure to risk? The Junior League was an independent 501(c)(3) charitable organization,[156] but all arrangements were made on a temporary, ad hoc basis.

By 1981 City leadership also began to realize that because of the enormous amounts of money required, it would be extremely difficult, if not impossible, for the City of Philadelphia to pay for the restoration of the Fairmount Water Works entirely or mostly out of public funds. It would need significant private help. Seeking a more durable solution, Water Commissioner William J. (Bill) Marrazzo proposed the creation of a nonprofit entity that would raise money

[156] Enabled by the federal Tax Reform Act of 1969, under Section 501(c)(3) of Title 26 of the U.S. Code of Federal Regulations (26 CFR), the U.S. Internal Revenue Code, a qualifying organization (commonly referred to as a "charitable organization") is exempt from paying federal income tax (and many other taxes such as state and local sales tax). Most importantly for fundraising purposes, contributions to such an organization are generally deductible from the donor's federal income tax liability for the year in which the contribution was made. Most qualifying entities are either religious, charitable, scientific, literary, or educational organizations. See "Exemption Requirements—501(c)(3) Organizations," *Internal Revenue Service* (U.S. Department of the Treasury, 17 Feb 2022), <www.irs.gov/charities-non-profits/charitable-organizations/exemption-requirements-501c3-organizations>, accessed 14 May 2022.

from a variety of public and private sources and would work with the City to target the funds in a coordinated manner.[157]

When the Watering Committee Building was nearly destroyed in an arson fire that same year, the Junior League leveraged its own fundraising when it obtained a $38,000 matching grant[158] from the Pennsylvania Historical and Museum Commission[159] and contributed $42,000[160] of its own[161] toward the $244,000 cost[162] of restoring it. Federal and City funding made up the balance.[163]

In early 1984, Deputy City Solicitor Shelley J. Winkler reminded stakeholders that a City agency could create a nonprofit organization to raise money from private sources, provided the organization had an independent board. Such an arrangement would have three benefits. Private individuals and organizations could contribute without fear of their donations being diverted to the City's general fund and spent elsewhere, the City could also allow the nonprofit entity to arrange for work on City property without needing to follow the cumbersome and time-consuming fiscal process, and the nonprofit organization would not need to meet certain regulatory requirements. In other words, the nonprofit could work easier, faster, and cheaper than a City agency could.[164]

A new nonprofit organization was not created at this time, however. The Fairmount Park

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[157] Thomas Hine, "Water Power Can Pay to Rescue a Landmark," *Philadelphia Inquirer* (1 Nov 1981), B1, B4.
[158] The equivalent of approximately $123,800 in 2022.
[159] Junior League of Philadelphia, *1981 Annual Report* (Summer 1981), D-16.
[160] The equivalent of approximately $138,800 in 2022.
[161] Junior League of Philadelphia, *1983 Annual Report* (Summer 1983), D-5.
[162] The equivalent of approximately $795,000 in 2022.
[163] Peter Odell, Management and Development Coordinator, Fairmount Park Commission, to Watering Committee (memorandum), 22 Nov 1993, referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 43n.121.
[164] Shelley J. Winkler, Deputy City Solicitor, to William J. Marrazzo, PWD Commissioner, 2 Apr 1984, referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 44f, 44n.129.

Commission decided instead to use an existing nonprofit, Philadelphia Historic Preservation Corporation, Restoration Inc., for project management. PHPC[165] acted as construction manager and disbursed funds from the Junior League and other sources. The organization acted in this way, for example, during the first phase of the rehabilitation of the Old Mill House during this time.[166]

In 1990 the Brown Thompson Group, a partnership between developer Ed Brown and architect Mark B. Thompson, proposed the creation of a nonprofit organization to oversee "fundraising, restoration, and continual operation of the Fairmount Water Works." Brown and Thompson suggested the name "Watering Committee," a nod to the historical City entity that oversaw the construction and management of the Fairmount Water Works and water distribution system prior to the Consolidation of 1854.[167] The Fairmount Park Commission gave its approval shortly after and engaged with the organization to coordinate planning and management. Fairmount Park Commission member Ernesta Ballard and former Water Department Commissioner Bill Marrazzo were chair and vice-chair.[168] It was soon formalized as a sub-committee of the Fairmount Park Commission's Development Committee.[169]

Two strong women were instrumental in the effort to restore the Fairmount Water Works.

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[165] Also known as PHPC Restoration Inc.

[166] Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 45f.

[167] Brown Thompson Group, Fairmount Water Works Watering Committee Initiative (1991), referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 48n.140.

[168] Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 51, 51n.148. Bill Marrazzo has stated, however, that the Watering Committee did not have 501(c)(3) status. See William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.

[169] Watering Committee meeting minutes, 23 Nov 1993, referenced in *Elizabeth C. Harvey, The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 50.

Susan Myers was the first. The second was Ernesta Ballard (1920–2005).[170] Raised in a wealthy Main Line family, Ballard not only raised her own family but also became deeply involved in civic affairs. In her thirties, she started a gardening business and went on to lead the Pennsylvania Horticultural Society, turning the parochial Philadelphia Flower Show into a premier international annual event. A prominent feminist and supporter of women's rights, she served as vice president of the Pennsylvania Women's Political Caucus. For a time, she headed the Greater Philadelphia Cultural Alliance and was elected to the board of managers of the Philadelphia Foundation which she later chaired. A member of the Fairmount Park Commission for 20 years, Ballard was a tireless promoter and organizer for Fairmount's restoration.

As Susan Myers' involvement in the effort to save the Fairmount Water Works decreased because of advancing age and declining health, Ernesta Ballard caught the baton. Where Myers had pushed and prodded from the outside, Ballard worked more from within. Each in their own way were prodigious fundraisers.

In 1992, City Council created the independent nonprofit Fairmount Park Historic Preservation Trust. With 501(c)(3) status, its purpose was to aid in the preservation of city-owned historic properties within the Fairmount Park system.[171] Because members of City Council (including the Council President) were voting members of the Trust's board, it had more political muscle than other organizations, but it was also subject to political influences to a greater degree as well. Its focus was the adaptive reuse of historic buildings within the entire

[170] Rusty Pray, "'One of the Great Citizens' of Phila.," *Philadelphia Inquirer* (12 Aug 2005), A1, A12; John F. Morrison, "Ernesta Ballard, a 'Treasure,' Dies," *Philadelphia Daily News* (12 Aug 2005), 10; "A Philadelphia Icon Passes [editorial]," *Philadelphia Daily News* (12 Aug 2005), 17.
[171] "Who We Are: History," *Fairmount Park Conservancy* (2021), <https://myphillypark.org/who-we-are/history/>, accessed 19 Jul 2021.

Fairmount Park system, not just Fairmount.[172]

By 1995, however, the Watering Committee was dissolved and a new group, the Water Works Restoration Committee was created. As described later by participant Bill Marrazzo, the organization was meant to "formalize the informal civic effort to drive attention to the stabilization and restoration of the FWW." It was not a legal entity but a joint committee between Marrazzo, Susan Myers, John Milner Associates, and staff members from the Fairmount Park Commission and the Philadelphia Water Department.[173]

In 1998, Ernesta Ballard[174] created the independent Fund for the Water Works.[175] With 501(c)(3) status,[176] it became a long-lasting and highly successful fundraising organization. In fact, from 1998 to 2018, the organization raised and directed over $11 million[177] toward the restoration of Fairmount. Bill Marrazzo served as chairman and Bill Agate was vice-chair. Marilyn Sprague and Bill George were secretary and treasurer, respectively.[178]

The same year, Fairmount Park Commissioners John Binswanger and Ernesta Ballard created the independent, nonprofit Fairmount Park Foundation. With 501(c)(3) status it could receive private contributions intended for any of the properties managed by the Fairmount Park

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172 Lucy Strackhouse, former Senior Director of Preservation & Project Management, Fairmount Park Conservancy, telephone interview with author-editor, 26 Jul 2021. Because the Trust existed by City ordinance, it also had the ability to lease property in Fairmount Park for the City of Philadelphia.
173 William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.
174 William S. (Bill) George, CPA, former Treasurer, Fund for the Water Works, telephone interview with author-editor, 12 Nov 2021.
175 Fairmount Park Commission, *The Water Works, Philadelphia* (8 Sep 2001); "Fund for the Water Works," *Cause IQ* (2022), <www.causeiq.com/organizations/fund-for-the-water-works,911882472/>, accessed 14 Apr 2022.
176 Form 990 Filing for 2014, The Fund for the Water Works: Schedule O, *Supplemental Information to Form 990* (14 Nov 2015). See also annual Form 990 filings through 2018.
177 "Total Cumulative Disbursements, 1 Apr 1998–31 Dec 2018," *Fund for the Water Works, Monthly Treasurer's Report, Statement of Receipts and Disbursements* (Dec 2018), 1. The amount is roughly the equivalent of approximately $13 million in 2022.
178 Form 990 Filing for 2014, The Fund for the Water Works: Schedule O, *Supplemental Information to Form 990* (14 Nov 2015); William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021; William S. (Bill) George, CPA, former Treasurer, Fund for the Water Works, telephone interview with author-editor, 12 Nov 2021.

Commission. Three years later, the foundation was renamed the Fairmount Park Conservancy.[179] Although the Conservancy was a child of the Fairmount Park Commission, it raised funds independently of the Commission (as well as of City Council). It didn't have the political thrust of the Fairmount Park Historic Preservation Trust, but it was instrumental in raising funds for specific needs identified by the Fairmount Park Commission.

While the Trust focused on hands-on preservation and adaptive reuse of Fairmount Park system properties, the Conservancy engaged in fundraising from private donors for diverse purposes across the park system. Early on, the Conservancy disbursed funds for projects the Fairmount Park Commission was managing, but by around 2005 there was a dawning realization that it was much more efficient and effective to manage the projects itself—directly hiring contractors and the like. Even then, it did not have carte blanche but required approval by the Fairmount Park Commission.[180]

The Fund for the Water Works' Interpretive Center was established in 1999. Similar in construct to the Fund for the Water Works, akin to a "sister organization," the 501(c)(3) entity received private contributions intended to be applied exclusively to the Interpretive Center.[181]

In 2005, Ernesta Ballard was instrumental, just before she died, in creating the Women for the Water Works as a committee of the Fairmount Park Conservancy.[182] It was a high-

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[179] "Who We Are: History," *Fairmount Park Conservancy* (2021), <https://myphillypark.org/who-we-are/history/>, accessed 19 Jul 2021.

[180] Lucy Strackhouse, former Senior Director of Preservation & Project Management, Fairmount Park Conservancy, telephone interview with author-editor, 26 Jul 2021; Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.

[181] *Fund for the Water Works' Interpretive Center, Monthly Treasurer's Report, Statement of Receipts and Disbursements* (Dec 2018), 1.

[182] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021; Marilyn Sprague, former colleague of Susan Myers, Junior League of Philadelphia, former Secretary, Fund for the Water Works, telephone interview with author-editor, 16 Oct 2021.

visibility 501(c)(3) entity that raised money for specific projects at Fairmount, such as the restoration of the Cliffside Paths.[183]

After Philadelphia residents voted to abolish the Fairmount Park Commission in a 2008 referendum, the organization was dissolved two years later and its responsibilities and staff were merged into the Philadelphia Department of Recreation, creating Philadelphia Parks & Recreation.[184] This is the agency of the City of Philadelphia that now owns and manages the property and buildings of the Fairmount Water Works.

In 2015, the Fairmount Park Historic Preservation Trust was merged into the Fairmount Park Conservancy.[185] The "new" Conservancy is an independent 501(c)(3) organization that reports to neither City Council nor Philadelphia Parks & Recreation but does work closely with both, especially the latter. It adopted the board structure of the Trust, retaining members of City Council. The Conservancy combines the complementary functions of the Trust and Conservancy. Among other things, it raises funds and manages projects for the preservation, restoration, and adaptive reuse of historic properties within the Fairmount Park system.[186]

Today, a large part of Fairmount's preservation and maintenance funding comes from revenue from concessions on the property managed by Philadelphia Parks & Recreation.[187] The

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[183] Lucy Strackhouse, former Senior Director of Preservation & Project Management, Fairmount Park Conservancy, telephone interview with author-editor, 26 Jul 2021; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021.

[184] "Who We Are: History," *Fairmount Park Conservancy* (2021), <https://myphillypark.org/who-we-are/history/>, accessed 19 Jul 2021.

[185] "Who We Are: History," *Fairmount Park Conservancy* (2021), <https://myphillypark.org/who-we-are/history/>, accessed 19 Jul 2021.

[186] Some of the functions the Conservancy performs are activity programming, construction management, leasing management, and investment in national lands restoration projects and so-called "signature locations." Lucy Strackhouse, former Senior Director of Preservation & Project Management, Fairmount Park Conservancy, telephone interview with author-editor, 26 Jul 2021; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021; Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.

[187] Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.

Fund for the Water Works is the primary vehicle for private donors to contribute to the operation of the Fairmount Water Works Interpretive Center and its associated projects and programming.[188]

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For Fairmount as a whole, there was still the need for a guiding framework for decision-making. In 1979 the Philadelphia Water Department and Junior League[189] funded an adaptive reuse feasibility study by John Milner Associates. The architectural firm specialized in the reactivation of historic properties and had offices in West Chester and Center City Philadelphia.[190] Over the course of two years, the group made a thorough review of the site's history and completed a survey of its existing architecture and structural integrity. The landmark report, released in September 1981, consisted of two thick volumes in addition to an executive summary. After analyzing the pros and cons of eight ideas for reuse, in various combinations,[191] the report described in detail the numerous points of structural stabilization and architectural restoration that would be necessary under any concept.[192]

From an aesthetic standpoint, the "Milner Report" recommended restoring the buildings

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188 *Fund for the Water Works' Interpretive Center, Monthly Treasurer's Report, Statement of Receipts and Disbursements* (Dec 2018); William S. (Bill) George, CPA, former Treasurer, Fund for the Water Works, telephone interview with author-editor, 12 Nov 2021; William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021; Steinke, Paul R., Executive Director, Preservation Alliance for Greater Philadelphia, Treasurer, Fund for the Water Works, telephone interview with author-editor, 23 Jan 2023; "Fund for the Water Works," *Guidestar* (2022), <www.guidestar.org/profile/91-1882472>, accessed 11 Aug 2022.
189 Junior League of Philadelphia, *1981 Annual Report* (Summer 1981), D-16.
190 John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Executive Summary* (Sep 1981), 1.
191 John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Executive Summary* (Sep 1981), 14ff.
192 John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Appendix* (Sep 1981).

and grounds to their overall appearance "immediately following the last major phase of expansion in 1871."[193] The assorted stakeholders adopted this as a foundational principle for future restoration considerations, which it remains today. Other recommendations included concentrating on the exteriors of the buildings, but also restoring the interiors of the Watering Committee Building, Caretaker's House, and central room of the Engine House.[194] Under the plan, the City of Philadelphia would manage the exterior restoration and future operators would be responsible for making the interior improvements they needed. Any rent collected by the City would go toward regular maintenance.

Although the report recognized the desirability of excavating the Forebay, because of safety, pedestrian and vehicular circulation, emergency and service access, and other practical considerations, the report recommended instead that the Forebay area reflect the period after it was filled in during early years of the Aquarium operation.[195] A seemingly little-noted recommendation was the reproduction and reinstallation of the sculptures *Allegory of the Schuylkill River* within the Central Marble Fountain and *Mercury* atop the Mercury Pavilion.[196]

Two reuse proposals attracted attention early on. One was a hydroelectric plant.[197] The

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[193] John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Executive Summary* (Sep 1981), 9.

[194] John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Executive Summary* (Sep 1981), 9.

[195] John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: Executive Summary* (Sep 1981), 9f.

[196] John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: A Narrative Report* (Sep 1981), Fig. 15 (Schematic Site Sections).

[197] Cooperative Hydroelectric Development Associates, *Small Hydroelectric Power Development: Fairmount Dam* (23 May 1980); Tippetts-Abbett-McCaraty-Stratton, *Feasibility Study of Hydropower Development at Fairmount Dam on the Schuylkill River* (Aug 1981); Thomas Hine, "Water Power Can Pay to Rescue a Landmark," *Philadelphia Inquirer* (1 Nov 1981), B1, B4; "Making Water Do the Work [editorial]," *Philadelphia Inquirer* (10 Nov 1981), 18; Jack Smith, "A Phila. First: Electric Plan at Fairmount Dam," Evening Bulletin (21 Jan 1982), courtesy Special Collections Research Center, Temple University Libraries.

Water Department hired O'Brien & Gere Engineers[198] in 1982 to evaluate the historically fitting idea.[199] The firm investigated numerous factors such as tidal effects, the available head, historical landmark restrictions, and financial considerations[200] and assessed three potential locations[201] and three alternative turbine-generator designs.[202] Construction time was estimated to be 20 months from go-ahead and cost approximately $7.8 million;[203] the projected annual operating cost was $953,000.[204]

O'Brien & Gere concluded that a hydroelectric facility constructed and operated in the New Mill House by a private firm was indeed technically feasible but was only financially viable if the company could take advantage of certain tax benefits. Some tax credits, for example, only applied if the operator was a for-profit entity that owned its site or had a long-term lease and could prove it had control of the property.[205]

The City of Philadelphia applied for a power station license.[206] When the Fairmount Park Commission and Philadelphia Water Department issued a joint request for qualifications on 1 Jul

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[198] Based in Syracuse, New York, the company maintained a regional office in Philadelphia. In 2019 it was acquired by the Rambøll Group A/S, a Danish engineering firm. See "Denmark Firm to Acquire Syracuse's OBG Engineering Company," *Advance Local Media LLC* (17 Dec 2018), <www.syracuse.com/business/2018/denmark-firm-acquires-syracuses-obg-engineering-company.html>, accessed 12 Jan 2023.
[199] From 1822 to 1911, of course, Fairmount Water Works converted the gravitational potential energy of falling water into mechanical energy in order to pump water into Philadelphia's water distribution system. Recall also that a proposal was made in 1911 to convert the Fairmount Water Works into a hydroelectric plant as a means of providing power and light for facilities throughout the Fairmount Park system. The mayor at the time ultimately rejected the idea. See "Mystery Hangs Over City Hall," *Philadelphia Inquirer* (19 Sep 1911), 2; "Urges Converting of Water-Works Into Power Plant," *Philadelphia Inquirer* (24 Sep 1911), 15.
[200] O'Brien & Gere Engineers, Inc., *Fairmount Dam: Hydroelectric Development Schuylkill River* (Sep 1982), 5.
[201] O'Brien & Gere Engineers, Inc., *Fairmount Dam: Hydroelectric Development Schuylkill River* (Sep 1982), 20ff. Three locations were evaluated: the New Mill House, Mound Dam, and western end of Fairmount Dam.
[202] O'Brien & Gere Engineers, Inc., *Fairmount Dam: Hydroelectric Development Schuylkill River* (Sep 1982), 25ff.
[203] The equivalent of approximately $24 million in 2022.
[204] O'Brien & Gere Engineers, Inc., *Fairmount Dam: Hydroelectric Development Schuylkill River* (Sep 1982), 5. The amount was the equivalent of approximately $2.9 million in 2022.
[205] O'Brien & Gere Engineers, Inc., *Fairmount Dam: Hydroelectric Development Schuylkill River* (Sep 1982), 6f.
[206] City of Philadelphia, *Application for License: Fairmount Dam Hydroelectric Power Project, FERC Project No. 3227* (30 Sep 1983).

1984,[207] six potential operators responded.[208] Within two years, however, many of the tax benefits had expired and the financial viability of the project evaporated. Hydroelectric power at Fairmount was never implemented.[209]

Although a power plant did not materialize, one of the supporting studies did result in a thorough assessment of the safety of Fairmount Dam. O'Brien & Gere's feasibility assessment included a standalone report from Walker Diving Contractors, Inc., of Laurel Springs, New Jersey.[210]

The underwater inspection revealed that the toe of the concrete spillway was indeed keyed into sound bedrock along the entire length of the dam, as specified by original drawings. Between 100 and 500 feet from the Pier at the eastern end, however, a large number of original timbers were seen to have been incorporated into the concrete portion, with several protruding from the surface of the concrete. Minor spalling and cracking was also observed near joints in the concrete. Significant quantities of silt lay against the upstream face of original timber portion of the dam. None of this was considered to be questionable.[211]

One potential problem was discovered. At a point approximately 250 feet from the Pier, a hole 14 feet long, 4 feet high, and 6 feet deep had eroded into the downstream toe. It was thought to be the result of progressive scouring at a joint between two sections of the concrete. No flow through the hole or the joint was detected and it was judged to be sound.[212]

Although the silt along the upstream face of the dam increased pressure against it, the

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[207] Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 43n.124.
[208] Walter F. Naedele, "Restoring the Glory of a Landmark," *Philadelphia Inquirer* (25 Jan 1984).
[209] *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?*, Elizabeth C. Harvey (University of Pennsylvania, 1997), 44.
[210] O'Brien & Gere Engineers, Inc., *Fairmount Dam Inspection and Assessment* (Jan 1983), 1.
[211] O'Brien & Gere Engineers, Inc., *Fairmount Dam Inspection and Assessment* (Jan 1983), 2ff.
[212] O'Brien & Gere Engineers, Inc., *Fairmount Dam Inspection and Assessment* (Jan 1983), 3.

inspection team determined that Fairmount Dam was stable against overturning or sliding during normal conditions, during icy conditions, and during the extreme conditions of a 500-year flood.[213] The only corrective recommendation was the application of grout or concrete where the potentially problematic scouring and eroding of the toe had occurred. Routine safety inspections were recommended to be conducted every five years.[214]

The second reuse idea that attracted attention had more staying power—a year-round restaurant.[215] The May 1982 fire in the Engine House that had effectively ended the operation of the Water Works Café occurred while the Milner report was being composed. Nevertheless, when the joint request for qualifications was issued in 1984, the request also solicited qualified restaurateurs; as with the hydroelectric idea, six potential operators expressed serious interest.[216] Although the process was not immediately pursued, it would eventually bear fruit.

Meanwhile, specific projects in support of an eventual total restoration were being accomplished. At the request of the Junior League of Philadelphia, the Fairmount Park Art Association[217] funded the creation of synthetic composite reproductions of William Rush's carved wood portal sculptures.[218] It was decided to create reproductions so that the wood originals, held by the Pennsylvania Academy of the Fine Arts and the Philadelphia Museum of

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[213] O'Brien & Gere Engineers, Inc., *Fairmount Dam Inspection and Assessment* (Jan 1983), 8f.
[214] O'Brien & Gere Engineers, Inc., *Fairmount Dam Inspection and Assessment* (Jan 1983), 10.
[215] Thomas Hine, "Water Power Can Pay to Rescue a Landmark," *Philadelphia Inquirer* (1 Nov 1981), B1, B4.
[216] Walter F. Naedele, "Restoring the Glory of a Landmark," *Philadelphia Inquirer* (25 Jan 1984).
[217] Today called the Association for Public Art (aPA). See "What We Do," *Association for Public Art* (2023), <www.associationforpublicart.org/what-we-do>, accessed 12 Jan 2023.
[218] Junior League of Philadelphia, *1981 Annual Report* (Summer 1981), D-16; Nessa Forman, "A $7,500 Fiberglas Repro," *Evening Bulletin* (29 Apr 1979), courtesy Special Collections Research Center, Temple University Libraries. D. Dodge Thompson, Administrator of Curatorial Affairs at the Philadelphia Museum of Art at the time, was instrumental in initiating, supervising, and finding the funding for the project. See. D. Dodge Thompson to Timothy Rub, CEO, Philadelphia Museum of Art, and Theresa Stuhlman, Preservation & Development Administrator, Philadelphia Parks & Recreation, 26 Jun 2012; Mark Thompson, Principal, Mark Thompson Associates, telephone interview with author-editor, 25 Jan 2021.

Art on long-term loan from the Fairmount Park Commission,[219] would not be subject to the risk of vandalism or the damaging effects of the elements.

The project was completed in 1980[220] by sculptor Fred Kreitchet[221] for $7,500.[222] The condition of Rush's originals—*Allegory of the Schuylkill River in Its Improved State* (sometimes erroneously called "The Schuylkill Chained") and *Allegory of the Water Works* (sometimes erroneously called "The Schuylkill Freed")—was good enough to allow Kreitchet[223] and his team[224] to create direct casts.[225] For the finished reproductions, a committee chose Fiberglas™[226] for its light weight and overall strength, and Kreitchet recommended an epoxy resin be used with

[219] *Provenance card for accessions 12-1937-1 (Allegory of the Schuylkill River in Its Improved State) and 12-1937-2 (Allegory of the Water Works)*, Philadelphia Museum of Art; "*Allegory of the Waterworks* [sic] Is On Display In the Museum," *Philadelphia Inquirer* (23 Sep 1994), 142.

[220] D. Dodge Thompson, Chief of Exhibitions, Philadelphia Museum of Art, to C. Clark Zantzinger, Jr., President, Fairmount Park Art Association, 18 Aug 1978; C. Clark Zantzinger, Jr., President, Fairmount Park Art Association, to Darrel L. Sewell, Curator of American Art, Philadelphia Museum of Art, 21 Jan 1980; Photographic record, Philadelphia Water Department Historical Archives; Nessa Forman, "A $7,500 Fiberglas Repro," *Evening Bulletin* (29 Apr 1979), courtesy Special Collections Research Center, Temple University Libraries; Junior League of Philadelphia, *1981 Annual Report* (Summer 1981), D-16; Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022. The Thompson letter indicates the work of reproduction was imminent but had not yet begun in August 1978. Photographs and accompanying notes in the possession of the PWD archives indicate *Allegory of the Schuylkill River in Its Improved State* was in process on 14 Sep 1978 and *Allegory of the Water Works* was in process in August of 1979. The *Bulletin* article reports that the creation of the reproductive molds was underway in April of 1979. The Zantzinger letter projects the reproductions to be completed in April or May of 1980.

[221] Living in Center City Philadelphia at the time, Kreitchet was cross-street neighbors with a contact at the Philadelphia Museum of Art, who asked him if he would be interested in the reproduction work. Kreitchet responded positively and was interviewed by Susan Myers and Fairmount Park Art Association President Zantzinger, who subsequently contracted with him. Kreitchet's studio was located in Perkiomenville at the time. Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022.

[222] The equivalent of approximately $30,000 in 2022.

[223] "Kreitschitz" at the time. He legally changed his name around 1984 in order to simplify the name for his children.

[224] Among the contributors were artist Karen Graham, who assisted throughout the entire process, and sculptor Steve Weiss, who assisted during the molding process. Jackie St. Ledger, David Freas, ceramic sculptor Lorraine Oerth, and craftsman Tom Rutkowski also participated.

[225] As early as 1914, Aquarium Superintendent William E. Meehan had expressed concern regarding the condition of Rush's portal sculptures and the difficulty of properly maintaining them. See Meehan to Jesse T. Vogdes, Chief Engineer of the Fairmount Park Commission (2 May 1914).

[226] Fiberglas™ is an extruded glass fiber product created in 1936 by Owens Corning. When used as a reinforcing component within a plastic material, the combined composite is often called "fiberglass." See "Fiberglas™," *Owens Corning* (2022), <www.owenscorning.com/en-us/insulation/fiberglas#residential-products>, accessed 13 Jul 2022; Mitch Jacoby, "What's Fiberglass?" *Chemical & Engineering News* (22 Sep 2018), <https://cen.acs.org/materials/inorganic-chemistry/s-fiberglass-does-delicate-material/96/i38>, accessed 13 Jul 2022.

it because of its low shrinkage factor, strength, and superior resistance to weathering.[227]

The work was neither easy nor quick.[228] Kreitchet and his team labored on *Allegory of the Schuylkill River in Its Improved State* from the fall of 1978 into the following year, and on *Allegory of the Water Works* from the summer of 1979 to the spring of 1980. Administrators at the Philadelphia Museum of Art provided a workspace in the basement of the museum for the making of molds from the original sculptures. The molds were then taken to Kreitchet's studio in Perkiomenville, Pennsylvania,[229] where the finished reproductions were created.

The process was the same for each sculpture.[230] Two coats of Butcher's wax[231] were first applied to the bare wood.[232] Next, the sculpture was coated with two layers of silicone rubber which was applied as a liquid. On the suggestion of sculptor Steve Wiess, Kreitchet's assistant for this portion of the process, cheesecloth was pressed into the rubber. Because the rubber would later become the mold used to produce the finished reproduction, the cheesecloth would strengthen it against tears as it was removed from the original sculpture.

[227] Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022.
[228] "It was a nightmare of a job, it really was. I had obtained a Master's degree in sculpture at the University of Pennsylvania just three years before. It was very difficult, very involved, very intricate, and the originals were incredibly valuable. It was a terrifying project. I was warned by an administrator at the Museum of Art to be very careful with the originals. No kidding; of course I'm going to be careful. They were worth over a million dollars each when I received them." Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022. Adjusted for inflation, the million-dollar figure would be the approximate equivalent of $4.5 million in 2022, but this does not consider potential market valuation. The true current value of Rush's original portal sculptures is undetermined.
[229] Approximately 35 miles northwest of Fairmount and the Philadelphia Museum of Art.
[230] Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022.
[231] Invented in 1880 by Charles Butcher and sometimes called "bowling alley wax," Butcher's wax is a combination of carnauba wax and microcrystalline wax with turpentine and mineral spirits as softening agents. It is used to protect wood against surface contamination and has a variety of common uses, including cleaning furniture and buffing wood floors. See "6 Amazing Uses of Butcher's Wax: What Is Butcher's Wax?" *Offbeat Bros* (2018–2022), <https://offbreatbros.com/butchers-wax-uses>, accessed 13 Oct 2022.
[232] In 1914, Fairmount Park Aquarium Superintendent William Meehan had the white paint burned off the portal sculptures. After their condition was assessed, they were repainted white. See Meehan to Jesse T. Vogdes, Chief Engineer of the Fairmount Park Commission (2 May 1914). Two years after the Fairmount Park Commission gave the sculptures to the Philadelphia Museum of Art on long-term loan in 1937, museum administrators once again removed the paint. The sculptures were delivered to Kreitchet in a bare wood condition. Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022.

After the silicone rubber cured, plaster was applied over it in interlocking sections, creating a supporting shell. For additional support in particularly delicate areas, a polyester resin was applied directly over the rubber to form the shell. The rubber with its plaster and polyester outer shell would become the mold used to produce the finished reproduction. Because the workspace in the Art Museum was cold, plastic tenting was constructed over the work and a heater was placed inside the tenting to maintain the proper ambient temperature for the curing of the materials.

After the plaster dried and the polyester resin cured, the shell sections they comprised were removed from the rubber mold. The rubber mold was then cut into sections that matched the shell sections and peeled away from the original sculpture. This is where the Butcher's wax did its work to protect the original, serving as a releasing agent that prevented bits of wood from being pulled away with the rubber.

Approximately 175 sections were needed for *Allegory of the Schuylkill River in Its Improved State*, while some 215 were required for the more difficult *Allegory of the Water Works.* For sculptures that were each about 7½ feet long, 3½ feet high, and 2½ feet wide, this was byzantine work indeed.

After the mold sections were removed from the original sculptures, they and their shell sections were taken to Kreitchet's studio while the originals remained with the Museum. In the studio, the team ensured that each of the rubber molds was properly nested into its corresponding plaster or polyester shell. The mold-and-shell sets were used to create numerous small portions of the reproduction which would then be assembled into the finished product. Some of the sets could be joined together to form larger combinations, but many were used singly.

Kreitchet and his team next brushed a thick liquid epoxy resin into the inner surface of

each of the molds in turn. After the epoxy resin cured, the mold-and-shell set was removed to reveal a segment of the sculpture. As this process was repeated for each of the mold-and-shell sections, additional “building blocks” were produced.

When all of the segments had been created, they were carefully aligned and cemented together using small dots of epoxy glue. The seams were filled with a caulk-like combination of epoxy and Cab-o-sil®,[233] a product that renders epoxy into a putty-like consistency. The epoxy filler was squeegeed flush and sanded smooth after it cured.

The epoxy resin of the reproductions is white in color, but a white epoxy coating was applied to the exterior of the sculptures. This protects the resin from the damaging effects of ultraviolet light from the sun. The coating also provides a sacrificial surface that can be reapplied as needed. The projected lifetime of each of the reproductions is over a hundred years.

The finished reproductions are hollow, with the walls approximately a quarter of an inch thick.[234] Wood bracing was used in the interior for support during transportation, but the shape is stable. Although Kreitchet and his team were not aware of the history of the workers’ graffiti on the roof trusses of the Engine House, they unknowingly participated in that long tradition[235] by signing their names on the interior surfaces of the finished reproductions. Not outwardly visible, the inner graffiti remain to this day.

The plinths atop the portals had been empty since the Fairmount Park Commission provided Rush’s sculptures to the Art Museum on long-term loan in 1937,[236] but they would have to wait a little longer before they received the replacement sculptures; the reproductions

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[233] Produced by the Cabot Corporation, Cab-o-sil® is one brand of a finely powdered hydrophilic fumed silica product commonly used as a thickening agent in a variety of applications. See “Hydrophilic Fumed Silica,” *Cabot* (2022), <www.cabotcorp.com/solutions/products-plus/fumed-metal-oxides/hydrophilic>, accessed 31 Oct 2022.
[234] Somewhat like a modern Fiberglas™ bathtub or boat deck.
[235] Recall that the oldest legible graffito, on one of the roof trusses, is from 1842.
[236] *Provenance card for accessions 12-1937-1 (Allegory of the Schuylkill River in Its Improved State) and 12-1937-2 (Allegory of the Water Works),* Philadelphia Museum of Art.

were placed in temporary storage for future installation at a more suitable stage in Fairmount's restoration process.[237]

If either City leadership or the public needed a reminder of the risk associated with allowing Fairmount to deteriorate, one was amply provided in 1981 when an arson fire gutted the Watering Committee building and destroyed its roof.[238] The Junior League attracted a $38,000 matching grant[239] from the Pennsylvania Historical and Museum Commission and raised a further $42,000.[240] The remainder of the $244,000 cost[241] of its restoration was paid for by federal and City funding.[242]

An historically accurate restoration[243]—including the reproduction of authentic plaster over wood lathe in the interior[244]—was designed by John Milner Associates and carried out from August 1982 to April 1983 by general contractor J. S. Cornell & Son. Mayor Greene unveiled a dedicatory plaque during a ceremony in which City of Philadelphia officials and representatives from Washington, D.C. participated.[245] This was the first structure of the Fairmount Water Works to be fully restored.[246]

Restoration of the Caretaker's House was completed at the end of June 1984. The

[237] Junior League of Philadelphia, *1987 Annual Report* (Summer 1987), D-7; *Photographic record* (16 Aug 1988), Matt Smith, Photographer.
[238] Thomas Hine, "Water Power Can Pay to Rescue a Landmark," *Philadelphia Inquirer* (1 Nov 1981), 27, 30.
[239] The equivalent of approximately $124,000 in 2022.
[240] Junior League of Philadelphia, *1983 Annual Report* (Summer 1983), D-5. The amount is the equivalent of approximately $137,000 in 2022.
[241] The equivalent of approximately $795,000 in 2022.
[242] Peter Odell, Management and Development Coordinator, Fairmount Park Commission, to Watering Committee (memorandum), 22 Nov 1993, referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 43n.121.
[243] *Photographic record,* Fairmount Park Historic Resource Archives; Thomas Hine, "Restored," *Philadelphia Inquirer* (27 Apr 1983), 8B.
[244] Fairmount Park Commission, *Specifications for Restoration of the Watering Committee Building at Fairmount Waterworks* (2 Jul 1982).
[245] Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-15; *Photographic record*, Fairmount Park Historic Resource Archives; Thomas Hine, "Restored," *Philadelphia Inquirer* (27 Apr 1983), 8B.
[246] Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-15.

$295,000 total cost[247] was partially funded by a $97,000 matching grant[248] the Junior League's Restoration Committee obtained from the Pennsylvania Historical Museum Commission. The City of Philadelphia contributed the balance of the necessary funds.[249] A combined dedication ceremony and press conference was held in October by Mayor Wilson Goode.

Earlier the same year a special event was hosted by Mayor Greene at City Hall. Attended by corporate and charitable foundation heads, it featured an audio-visual presentation by John Milner on the reuse feasibility study his firm had conducted and served to promote the historic significance of the site. This resulted in the Junior League receiving two grants—$1.5 million[250] from the Pew Memorial Trust and $300,000[251] from the William Penn Foundation.[252] Together, the $1.8 million[253] was earmarked for the stabilization and restoration of the Old Mill House, what the Junior League referred to as the "keystone" of the restoration project.[254]

By 1986 the Junior League had received an additional $250,000[255] from the William B. Dietrich Foundation, $200,000[256] from the Commonwealth of Pennsylvania, and $1.1 million[257] from the City of Philadelphia.[258] The combined amount of $1,550,000[259] allowed the Fairmount

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247 Peter Odell, Management and Development Coordinator, Fairmount Park Commission, to Watering Committee (memorandum), 22 Nov 1993, referenced in Elizabeth C. Harvey, *The Fairmount Water Works: Can This National Historic Landmark Be Restored With Help From a Municipally Supported Nonprofit Organization?* (University of Pennsylvania, 1997), 44n.126. The amount was the equivalent of approximately $840,000 in 2022.
248 The equivalent of approximately $276,000 in 2022.
249 Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-16; Junior League of Philadelphia, *1985 Annual Report* (Summer 1985), D-21.
250 The equivalent of approximately $4.2 million in 2022.
251 The equivalent of approximately $855,000 in 2022.
252 The Pew Memorial Trust was part of the Pew Charitable Trusts. Funds were administered by the Glenmede Trust Company. See Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-2.
253 Due to the large size of the grants relative to Junior League finances, the organization requested and received from the Internal Revenue Service a determination of "unusual grant" so that it the funds would not be taxable. See Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-2. The total amount was the equivalent of approximately $5.1 million in 2022.
254 Junior League of Philadelphia, *1984 Annual Report* (Summer 1984), D-2, D-16.
255 The equivalent of approximately $675,000 in 2022.
256 The equivalent of approximately $540,000 in 2022.
257 The equivalent of approximately $3 million in 2022.
258 Fairmount Park Commission, *1986–87 Annual Report* (Jun 1987), 12.
259 The equivalent of approximately $4,215,000 in 2022.

Park Commission to begin the rehabilitation of the Old Mill House and restoration of its associated structures. The Junior League contracted with Philadelphia Historic Preservation Corporation[260] to manage the construction.[261] Architect David Hollenberg of John Milner Associates oversaw the work.[262]

Phase I got underway in April 1986 and was completed in June 1987. During the 1981 feasibility study, structural engineering subcontractor Keast & Hood of Philadelphia had determined that the existing deck of the Old Mill House was unsafe. The wrought iron T-beams embedded in the brick barrel vaults were expanding from corrosion, the supporting wrought iron Phoenix columns had corroded, the deck was showing visible signs of cracking from within, and rainwater regularly penetrated the structure. It was judged to be in danger of collapse.[263]

The deck of the Old Mill House, between the Watering Committee Building and the Caretaker's House, was demolished and replaced with a two-foot-thick, reinforced concrete structure supported by two-foot-diameter, cast-in-place concrete columns. Unfortunately, all 24 of the wrought-iron Phoenix columns, installed in the Old Mill House from 1867 to 1870, were removed and scrapped; inexplicably, none were salvaged and preserved. (This left only four Phoenix columns remaining, all beneath the Engine House deck.) All of the remnants of the Aquarium interior inside the Old Mill House, including display tanks, work areas, piping, and

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[260] In 1996 the PHPC (begun in 1979) merged with the Preservation Coalition of Greater Philadelphia (begun in 1982) to create the Preservation Alliance for Greater Philadelphia. The Preservation Alliance is still active today. See "About Us," *Preservation Alliance for Greater Philadelphia* (2015), <www.preservationalliance.com/about/mission-and-hbistory>, accessed 25 Apr 2022.
[261] Junior League of Philadelphia, *1987 Annual Report* (Summer 1987), D-7; Fairmount Park Commission, *1986–87 Annual Report* (18 Nov 1988), 12, 18; Fairmount Park Commission, *1988–89 Annual Report* (Jun 1989), 2.
[262] See for example John Milner Associates, Inc., *Project Manual for Contract No. 2, General Construction: Rehabilitation and Restoration of the Old Mill House at the Fairmount Waterworks* (19 Jul 1985).
[263] John Milner Associates, *Adaptive Reuse Feasibility Study, Fairmount Water Works: A Narrative Report* (Sep 1981), 55ff, 110; David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.

wiring, as well as the boiler room and HVAC[264] systems, were demolished. A new concrete floor was constructed at the approximate level of the Aquarium floor, roughly 13½ feet below the interior ceiling.[265]

Prior to the installation of the new concrete floor, archeological investigations were carried out.[266] The turbine flumes and tail races were excavated and a few fragments of the turbines and support frames were recovered. The inner Forebay was partially excavated, temporarily, and the work room which had been constructed under the Forebay Bridge during the Aquarium years was demolished.

Before the original deck could be demolished, the roof structure of the Pavilion was elevated by a small team of Amish men using hydraulic jacks[267] and all of the columns were removed. The roof was then temporarily supported on multiple stacks of wood cribbing. Each Entrance House, however, was lifted as a unit and placed upon shoring in the area behind the Engine House.

By the time the first phase was completed, the Junior League had directed $2.7 million to the Fairmount Park Commission for the restoration of the Fairmount Water Works.[268]

During the second phase of construction, which required an additional $1 million,[269] the Pavilion and Entrance Houses were restored, the balustrade was restored, and paving bricks were installed atop the new deck. Only four of the Pavilion's 26 columns were in good enough shape to be renewed and restored. The remainder had deteriorated to the point that they needed to be

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[264] HVAC, pronounced "AICH-vack," is the common abbreviation for "heating, ventilation, and air conditioning."
[265] Measurements taken by author-editor.
[266] Joel T. Fry, *A Summary Report of Archaeological Work to Date, at the Turbine Pump Wet Well, Fairmount Water Works* (2 Sep 1988).
[267] David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.
[268] Fairmount Park Commission, *1986–87 Annual Report* (Jun 1987), 18. The amount is roughly equivalent to approximately $8 million in 2022.
[269] The equivalent of approximately $2.5 million in 2022.

replaced with reproductions.[270]

Only two significant hitches were encountered during the work. The first was with the Pavilion's replacement columns.

Ancient Greek and Roman columns incorporated something called "entasis,"[271] a barely perceptible narrowing from bottom to top. In classical examples, the lower third is cylindrical while the upper two thirds taper toward the top following an elaborate geometry.[272] The original columns of the Pavilion do indeed feature entasis, but a more informal version. The reproductions did not conform to the "folk entasis"[273] seen in the original columns of the Pavilion but were instead crafted according to classical entasis geometry. They not only did not match the four remaining originals, but they were not historically accurate for Fairmount. The new columns were sent back, to be reworked to match the originals.[274]

The other snafu involved the balustrade. The original rail and balusters are cast iron with a textured paint to make them look like stone. Some of them were restored, but many were beyond repair, corroded mostly at their bases and just below the rail. Historically accurate reproductions were manufactured and all were coated with a product that contained a sand

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270 Fairmount Park Commission, *1986–87 Annual Report* (Jun 1987), 12; David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022

271 Pronounced "ENT-tə-sis," from Greek, meaning "to stretch or strain."

272 Although there are no surviving explanations from antiquity, it has long been thought that it was employed as an optical illusion to compensate for a supposed human tendency to perceive a concavity or hollowness in columns with perfectly parallel lines. Recent scholarship, however, has suggested that it may have been used instead to either give important structures the illusion of weight and gravitas, or to simply provide requisite strength. See Steen Eiler Rasmussen, *Experiencing Architecture,* 2nd edition (MIT Press, 1964), 37; Peter Thompson, et al., "The Origins of Entasis: Illusion, Aesthetics, or Engineering?" *Spatial Vision,* Vol 20, No. 6 (Department of Psychology, University of York, UK, 5 Feb 2007), 531ff, esp. 541f.

273 As David Hollenberg refers to it. David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.

274 David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.

component, produced by the Tnemec Company.[275] The appearance was historically accurate, but two years later the application began to flake off. Initially, the Milner architects, the subcontractor, and the Tnemec Company all pointed fingers at each other. The contractor threatened a lawsuit, because without compensation they alone would be forced to cover the cost of fixing the problem.

Instead, the parties agreed to a mediation process, which determined that the coating[276] was not consistently applied according to the recommended temperature application restrictions. All three recognized that they shared some of the blame—John Milner Associates acknowledged that their specifications were not as stringent as they should have been, the subcontractor admitted that they were perhaps not as careful as they should have been, and Tnemec realized that their recommendations for the product could stand to be tightened. In the end the three parties each contributed to the cost of the rework.[277]

On 16 Aug 1988, shortly before Phase II was completed, the reproductions of William Rush's portal sculptures were installed above the doorways to the Entrance Houses. *Allegory of the Schuylkill River in Its Improved State* and *Allegory of the Water Works* were placed atop the North and South Entrance House portals, respectively.[278] Funded by the Junior League and Fairmount Park Art Association, the casts had been held in temporary storage since they were completed eight years earlier. The plinths atop the entrance portals had been empty since 1937

[275] Tnemec, Inc., is a well-known industrial coatings company based in Kansas City, Missouri. See *Tnemec* (2022), <www.tnemec.com>, accessed 4 Aug 2022.
[276] The words "paint" and "coating" are colloquially used somewhat interchangeably, but a paint is primarily for decorative purposes while a coating provides protection against corrosion. See Chrissy Stewart, "The Composition of a Paint Coating," *Corrosionpedia* (14 Feb 2019), <www.corrosionpedia.com/the-composition-of-a-paint-coating/2/3247>, accessed 5 Oct 2022.
[277] David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.
[278] *Photographic record* (16 Aug 1988), Matt Smith, Photographer.

when the originals sculptures were given on long-term loan to the Art Museum.[279]

The rehabilitated Old Mill House and deck structures were dedicated in October of 1988.[280] During the celebration, Fairmount Park officials announced that one of their primary goals was to restore the Engine House for use as a restaurant.[281]

In 1988 the Fairmount Park Commission completed the first phase of the renewal of the Esplanade, the riverside ribbon below the South Garden. The work involved the restoration of the Granite Staircase at the northern end, the installation of a spiral stair at the southern end, removal of invasive species, repair of erosion, the installation of interpretive sculptures and plaques, and the installation of *The Fisherman,* a life-size sculpture of a man fishing with his tackle box next to him, on a prominent outcropping of rock near the Esplanade's mid-point. Completed in July of the same year,[282] using a silicon-bronze alloy, creator Gary Siegel cast his own torso, arms, and legs but sculpted the model for the head separately.[283] The sculpture soon became a visitor favorite.

F B. Davis Sons, Inc., of Newtown Square, Pennsylvania, completed the restoration of the Eagle Pavilion for the Fairmount Park Commission in July of the following year. The work

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[279] *Provenance card for accessions 12-1937-1 (Allegory of the Schuylkill River in Its Improved State) and 12-1937-2 (Allegory of the Water Works),* Philadelphia Museum of Art. The sculptures had been installed atop the Entrance Portals in 1825. Unfortunately, neither Fred Kreitchet nor any of the members of his team who had completed the reproductions in 1980 were notified of or invited to the installation. Fred Kreitchet, Principal, Sculpture Workshop, personal interview with author-editor, 10 Oct 2022, 1 Nov 2022.

[280] Junior League of Philadelphia, *1989 Annual Report* (Summer 1989), 3.

[281] Fairmount Park Commission, *1988–89 Annual Report* (Jun 1989), 2.

[282] Philadelphia Water Department, *Press Release* (17 Jun 2004), <http://www.businesswire.com/news/home/20040617005633/en/ Philadelphias-Favorite-Fisherman-Regains-Place-Schuylkill-Esplanade>, accessed 9 Jun 2017; C. Drew Brown, Public Education Manager, Philadelphia Water Department, telephone interview with author-editor, 28 Jun 2017; Gary Siegel, Principal, New Arts Foundry, Baltimore, Maryland, telephone interview with author-editor, 30 Jun 2017. Although the press release states the sculpture was commissioned in 1990, both Brown and Siegel confirm the work was installed in 1988.

[283] Gary Siegel, Principal, New Arts Foundry, Baltimore, Maryland, telephone interview with author-editor, 30 Jun 2017.

did not yet include the replacement of the missing eagle at the pinnacle of the roof, however.[284]

In November 1990, the restoration of the riverside deck of the Engine House was completed using funds contributed by the Junior League. Constructed in 1881, the deck was much like its larger Old Mill House counterpart—a series of brick barrel vaults between wrought iron beams, all supported by four wrought iron Phoenix columns. The deck sheltered the interior space that contained the original test turbine and its pump. The columns had deteriorated to the point that they were no longer able to safely support a large number of people on the deck above. Some type of structural remediation needed to be done.

The easiest, safest, and least costly alternative was to do what was done with the Old Mill House deck—demolish it and replace it with a concrete structure.[285] From within the Water Department's Public Affairs Division, however, Public Education Manager Drew Brown began pushing for another alternative, one that would not destroy the surviving original structure, namely retention of the historic deck using secondary structural support.[286] When Keast & Hood structural engineer Nick Gianopulos determined that the concept was feasible,[287] project architect David Hollenberg began to advocate for it as well,[288] although he and PHPC Restoration Vice President Bill Blades cautioned that from a purely performance standpoint, the complete

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[284] *Photographic record,* Fairmount Park Historic Resource Archives; F.B. Davis Sons, Inc. to Fairmount Park Commission (21 Jul 1989).

[285] Memorandum from Joan Fredette [Becker], General Manager, Customer Affairs, to William J. Marrazzo, Commissioner, Philadelphia Water Department, 21 May 1987. At the time, Joan Becker used her married name, Fredette. Shortly before leaving the Water Department, she changed to her maiden name, Becker. Joan Becker, former General Manager, Public Affairs Division, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.

[286] Brown had been hired by the Water Department in 1978 and transferred to Public Affairs in 1985.

[287] Nicholas L. Gianopulos, Keast & Hood Co., to David A. Hollenberg, John Milner Associates, 22 Jun 1987. Letter and accompanying drawings.

[288] David A. Hollenberg, John Milner Associates, to William S. Blades, Executive Vice President, PHPC Restoration, Inc., 30 Jun 1987.

demolition alternative was preferrable.[289]

The weight of Gianopulos' professional reputation—and Drew Brown's quiet persistence—eventually won the day.[290] Brown convinced everyone that it was desirable; Gianopulos' showed everyone that it was achievable. A supplementary support system consisting of narrow, steel I-beams, connected to the walls, was constructed.[291] The barrel-vaulted brick ceiling and all four of the Phoenix columns were left intact and in place.[292]

Hollenberg later reflected that saving the Engine House deck may have partly been the way that many of those involved made a little bit of peace with having to remove the entire original structure of the Old Mill House deck.[293] Brown recently remarked:

> When I watched the heavy equipment struggle to demolish the Old Mill House deck, I wondered why we were really doing it. It seemed to me that it had much more strength than we gave it credit for. It was also a historic structure, demonstrating the new technology of the time. I convinced Milner's people to admit that the surviving historic fabric of the Engine House deck could be saved. Of my contributions to the restoration of the Fairmount Water Works, that is my proudest.[294]

The outside surface of the deck was removed by hand and the top edges of the iron beams were replaced with historically sensitive steel elements, a waterproofing membrane was installed beneath new brick pavers, and the bezels in the skylights were replaced. The project also

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[289] William S. Blades, Executive Vice President, PHPC Restoration, Inc., to William J. Marrazzo, Commissioner, Philadelphia Water Department, 2 Jul 1987; David A. Hollenberg, John Milner Associates, to PHPC Restoration, Inc., 27 Jul 1987.

[290] C. Drew Brown, Public Education Manager, Philadelphia Water Department, to Joan B. Fredette [Becker], Customer Affairs, Philadelphia Water Department, 27 Jul 1987.

[291] John Milner Associates, *Engine House Deck Restoration at the Fairmount Waterworks* (30 Sep 1988), drawings A-1, A-2, A-3, D-1, E-1, S-1.

[292] Fairmount Park Commission, *1990–91 Annual Report* (Jun 1991), 5. The only known older Phoenix columns still existing are those in the Frankford Arsenal in the Bridesburg neighborhood of northeast Philadelphia.

[293] David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.

[294] C. Drew Brown, Public Education Manager Philadelphia Water Department, telephone interview with author-editor, 7 Jun 2022.

included the hand demolition of the two concrete seawater tanks—holdovers from the Aquarium years—in the southern portion of the space below,[295] and the installation of minor plumbing and electrical fittings. On the exterior of the Engine House river wall, stucco was removed, the masonry was repointed, and stucco reapplied. The balustrade was restored. Lastly, new cast iron doors, transoms, and windows were installed in the river walls of both the Engine House and Old Mill House.[296]

Because of the original purpose of the Fairmount Water Works, water was intended to literally pass through it. It was also located in a flood plain. Because of this, the buildings were designed to flood without compromising their structural integrity. Structural engineering subcontractor Keast & Hood recognized that if during a flood, water was not allowed rise on the inside of the river wall at a rate comparable to the rise on the outside, the difference in hydrostatic pressure could destroy the buildings. To prevent this, all of the outer penetrations—windows, balcony doors, transoms, and the like—were designed to fail inward, or otherwise admit water into the interior.[297]

Although the 1981 Adaptive Reuse Feasibility Study prepared by John Milner Associates proposed that the Forebay area reflect the early 20th century period of the Aquarium years instead of the 1870s target of the buildings and other portions of the grounds, there was a measure of disagreement. Some of the stakeholders strongly believed that some sort of excavation of the Forebay was necessary for the proper public interpretation of Fairmount's historic function as a water pumping facility. A focused assessment of the feasibility of excavating the Forebay was

[295] Handwork was necessary on the tanks because concrete surrounded two of the Phoenix columns.
[296] John Milner Associates, *Fairmount Waterworks Engine House Package* (27 Jul 1987).
[297] David Hollenberg, Adjunct Professor and former University Architect, University of Pennsylvania, former Architect, John Milner Associates, telephone conversation, 2 Aug 2022.

completed in June of 1990.[298]

There were two complicating factors: sewers and visitor circulation. First, a concrete storm sewer now passed through the Forebay below the historic water level and a concrete sanitary sewer passed through it above the historic water level. Second, the confines of the space between the Old Mill House and the cliff face of Fairmount made pedestrian and vehicular access rather tight, even without scooping out the Forebay. Three major concepts and four variations of visitor circulation schemes were analyzed.

Marianna Thomas Architects developed a master plan that would see the outer and inner Forebay partially excavated close to its historic outline and allow planners the option of reintroducing water or planting with grasses and flowering plants, but none of this was ever accomplished. Instead, the grade in the area of the Forebay was merely lowered a little in order to expose some of the Forebay walls of both Mill Houses. A small parking area was constructed in the inner Forebay area next to a grass strip and the outer Forebay area was kept as a large grass lawn, albeit with a somewhat lowered grade.

Even though much rehabilitation and restoration work had been done, it seemed to be two steps forward, one step back. Throughout the 1990s, for example, the buildings' exteriors began to deteriorate once more. Graffiti reappeared. Balusters visibly rusted and some were broken or completely missing. The grounds had not yet received any restoration attention. The South Garden was overgrown. The railings on the Central Cliffside Path's Stone Arch Bridge had gone missing, requiring its closure of the path for safety's sake. The North Cliffside Path was so knotted with woody overgrowth as to be virtually impassible. Because of this, however, the relative seclusion of its serpentine course sheltered an on-again, off-again homeless encampment

[298] Marianna Thomas Architects, *Fairmount Water Works: Forebay Feasibility Study* (30 Jun 1990).

and became littered with cast-off trash, drug paraphernalia, and human waste.[299] The South Cliffside Path was the only one of the three to remain passible, but its surface had become uneven and difficult to walk. Despite this—perhaps because of this—the Fairmount Park Commission and Philadelphia Water Department began to offer public tours of the Fairmount Water Works,[300] helping to raise its public profile.[301]

A full restoration of the buildings' exteriors was still awaiting funding. In November of 1997, it was announced that the Pew Charitable Trusts was contributing $4 million[302] and the William Penn Foundation would donate $1.4 million.[303] Although this still left a shortfall of $1.4 million below the anticipated total cost of the project—expected to be raised from individual members of the public—it was enough to begin work. It would also be enough to provide a $1.5 million endowment[304] for maintenance of the complex, so that Fairmount would no longer be dependent on an irregular supply of funds from City Hall or City Council for its upkeep.[305]

The Fairmount Park Commission was already spending a combined $4.5 million[306] it had received from the City of Philadelphia and Commonwealth of Pennsylvania to renovate the interior of the Engine House for a restaurant operation. Added to the funds spent on safety renovations and partial restoration in the 1980s, the total amount at the time came to nearly $17

[299] Personal observation by the editor-author at the time.
[300] For example, Philadelphia Water Department, *Open House at the Historic Fairmount Water Works*, promotional poster (9 Nov 1991), collection of the Philadelphia Water Department Historical Archives.
[301] Fairmount Park Commission, *1990–91 Annual Report* (Jun 1991), 5. During the summer, tours were provided by the Philadelphia Ranger Corps. Throughout the remainder of the year, tours were available by special arrangement with Philadelphia Water Department's Fairmount Water Works Interpretive Center office.
[302] The equivalent of approximately $7.4 million in 2022.
[303] The equivalent of approximately $2.6 million in 2022.
[304] The equivalent of approximately $2.7 million in 2022.
[305] Larry Fish, "Funds Flow In to Fix Fairmount Waterworks," *Philadelphia Inquirer* (11 Nov 1997), B1, B5; Larry Avery, "Generating a Cash Flow," *Philadelphia Daily News* (11 Nov 1997), 8.
[306] The equivalent of approximately $8.3 million in 2022.

million.[307]

Although the ongoing restoration effort occupied most of the attention, sometimes smaller dramas temporarily took center stage. In December 1997, two agents from the FBI's Philadelphia Field Division paid an unannounced visit to the suburban Rutledge[308] home of 56-year-old George Csizmazia, an electrical contractor and history buff. Robert Wittman[309] and Michael Thompson were investigating the suspected theft of four artifacts from the Historical Society of Pennsylvania, a research library in Center City Philadelphia. The items—a Revolutionary War Lancaster County long rifle and three Civil War presentation swords—had been discovered missing two months earlier when the special collections manager had begun the Society's first thorough inventory in decades.

The agents were hoping to find some of the missing pieces in Csizmazia's home. What they found instead was stunning—over 200 historic 18th and 19th century artifacts worth $2 million to $3 million at the time,[310] all stashed upstairs and all stolen from the Historical Society. In addition to the items the two agents were hunting, there were things as diverse as a lock of abolitionist John Brown's hair and the flint-lock rifle he carried during his 1859 raid at Harpers Ferry, 50 other firearms of various description, 25 additional presentation swords, numerous U.S. Mint Indian $10 gold coins, a ring with a lock of George Washington's hair, a pair of Revolutionary War-era cuff links, a Georgian-era silver watch with a glass face, and mother-pearl opera glasses in a leather case.

Also discovered in the hoard was the silver commemorative vase that the Watering

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[307] Larry Fish, "Funds Flow In to Fix Fairmount Waterworks," *Philadelphia Inquirer* (11 Nov 1997), B1, B5; Larry Avery, "Generating a Cash Flow," *Philadelphia Daily News* (11 Nov 1997), 8. The amount was the equivalent of approximately $31.4 million in 2022.
[308] Located a few miles southwest of Philadelphia.
[309] Wittman would later help create the FBI's Art Crime Team and become its senior investigator and trainer. See "About Robert Wittman," *Robert Wittman Inc.* (2022), <www.robertwittmaninc.com/about>, accessed 18 Aug 2022.
[310] The equivalent of approximately $3.7–5.5 million in 2022.

Committee had in 1828 presented to Frederick Graff, Sr., in appreciation for his years of selfless service to the citizens of Philadelphia.[311] The Historical Society hadn't known it was gone.

It turned out that for the previous eight years, Csizmazia had been purchasing the items as 48-year-old Ernest Medford, a trusted custodian at the Historical Society, smuggled them out one by one. For Medford's trouble, Csizmazia had altogether paid the man the paltry sum of $8,000.[312]

The pair were charged in federal court[313] with theft of culturally significant items and they both pleaded guilty, hoping for light sentences. The prosecuting attorney recommended 20 months in prison each. The judge, a World War II veteran who took a dim view of historical theft, sentenced each of the thieves to 40 months instead.[314]

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Through the 1980s and 1990s, planning continued for two major reuses of the Fairmount Water Works—an interpretive center in the lower level of the Engine House and part of the Old

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[311] Stacey Swigart, Director, Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University, email correspondence with author-editor, 18 Aug 2022. Recall that the Watering Committee had presented Graff with two silver vases, one in 1816 and one in 1828.

[312] The equivalent of approximately $14,700 in 2022.

[313] Just three years earlier, the United States Congress had passed a law making the theft of important historical artifacts worth more than $5,000 a federal crime. Previously, if thieves hadn't crossed state lines, they could only be charged in state court. Robert K. Wittman and John Shiffman, *Priceless: How I Went Undercover to Rescue the World's Stolen Treasures* (New York: Broadway Books, 2010), 104; Joseph A. Slobodzian, "Pieces of City's History Recovered After Thefts," *Philadelphia Inquirer* (7 Jan 1998), A1, A8.

[314] Robert K. Wittman and John Shiffman, *Priceless: How I Went Undercover to Rescue the World's Stolen Treasures* (New York: Broadway Books, 2010), 93ff; Joseph A. Slobodzian, "Pieces of City's History Recovered After Thefts," *Philadelphia Inquirer* (7 Jan 1998), A1, A8. Today, the collection formerly housed at the Historical Society of Pennsylvania is part of the Atwater Kent Collection at Drexel University's Lenfest Center for Cultural Partnerships where, presumably, it is a great deal more secure. See Lee Arnold, CEO and Senior Director of the Library & Collections, Historical Society of Pennsylvania, email correspondence with author-editor, 27 Jan 2022; Stacey Swigart, Director, Atwater Kent Collection, Lenfest Center for Cultural Partnerships, Drexel University, email correspondence with author-editor, 18 Aug 2022.

Mill House and a restaurant on the main level and deck of the Engine House.

In 1984, Philadelphia Water Department Commissioner Bill Marrazzo created a new public affairs function within the Department. Prior to this, there was only a Public Relations Manager with a staff of one, a graphic artist. Because the city charter gave the Commissioner the unilateral authority to set water rates, previous Water Commissioners hadn't thought there was a need for any substantial interaction with the public and so didn't see the value in a fully developed public affairs function designed to communicate with the public.

Due in part to changes in federal and state regulations, however, it had become apparent to Commissioner Marrazzo around this time that spending on water infrastructure was going to need to be dramatically increased, and that water rates would need to be raised significantly in order to pay for it. If the Water Department had done what it had done in the past—simply raise rates to whatever level it decided was appropriate, with no public feedback or interaction—the public would have likely protested strongly enough that there would have been severe negative political consequences.[315]

For this reason, Commissioner Marrazzo created the Public Affairs division[316] to engage with the public about the need for a water rate hike and the benefits of what would be accomplished with it. In other words, Public Affairs would demonstrate the bang the public would get for its additional buck.[317]

Marrazzo hired Joan Becker[318] as the first General Manager of Public Affairs. With an

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[315] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.

[316] Initially called "Customer Affairs," by around 1990 the name had been changed to Public Affairs. For simplicity's sake, the unit will be referred to hereafter as Public Affairs.

[317] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.

[318] As noted earlier, at this time Joan Becker was using her married name, Fredette. Shortly before leaving the Water Department, she changed to her maiden name, Becker. Joan Becker, former General Manager, Public Affairs Division, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.

education degree, Becker was at the time working for the Fairmount Park Commission, managing numerous environmental centers and historic properties. One of Becker's innovations was the creation of "friends" groups to help look after the day-to-day operation of each of the assets. Managing Fairmount was so time-consuming that Becker had moved her office from the Fairmount Park Commission headquarters in Memorial Hall to the Watering Committee Building at Fairmount. Becker also served on the Fairmount Park Commissions Public Affairs Committee, attending meetings with Executive Director Pete Hoskins. Marrazzo saw that she was knowledgeable, outgoing, and able to handle delicate situations.[319]

In July 1985, Becker brought on C. Drew Brown as Public Education Manager, reporting directly to herself. Initially hired by the Water Department seven years earlier as an environmental engineer,[320] Brown had expanded and improved the sewage sludge composting operation at the Southwest Water Pollution Control Plant.[321] Later, as the manager of process control systems at the same sprawling location, he had helped install the first process control computer at any of the department's plants. Brown had technical expertise, was budget-savvy, and could explain things in ways that were easy for the average person to understand.[322]

A year later, Becker transferred Joanne Dahme to the Public Affairs team. Dahme had been working for the Water Department since 1980, most recently in the construction division as

[319] One of the public issues Becker was initially hired to help with was the building of the water pollution control plants and the recycling of the treated sewage sludge for use in remediating acid mine runoff in various locations throughout the state of Pennsylvania. William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021; Joan Becker, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.
[320] Environmental engineers were at that time called sanitary engineers. The professional nomenclature changed in the early 1980s.
[321] The facility was, and still is, one of Philadelphia's primary sewage treatment plants.
[322] C. Drew Brown, Public Education Manager, telephone interviews with author-editor, 30 Jun 2021, 8 Jul 2021, 7 Jun 2022; Joan Becker, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.

a construction manager.[323]

One of the primary missions of Public Affairs was two-fold: help people understand that the single biggest component in the prevention of disease in Philadelphia was the protection of its water supply and show the ways that the Water Department accomplished that, first by ensuring that the Delaware and Schuylkill Rivers were clean enough to fish and swim in, and then by purifying the water it took in before distributing it to the city's residents for their use. The team understood that the Fairmount Water Works was the historic initial building block of Philadelphia's modern municipal water utility and perceived that it could be used to educate the public about the importance of the role the Water Department plays in the lives of residents.

Joan Becker first came up with the idea of some sort of interpretive center at Fairmount. Commissioner Marrazzo quickly approved the idea and gave Public Affairs the responsibility for its creation. The team developed an initial concept and began to frame it as the cornerstone component of the Water Department's public education program.[324]

This then served to justify the Water Department's monetary and organizational contribution to the restoration of the Fairmount Water Works and the creation of the Fairmount Water Works Interpretive Center. It would have a strong historical element, to be sure, but it would primarily be a water education center. Were it not for the education theme, contributions by the Water Department of funds collected through water bills could be perceived as—and might actually be—simply giving away people's hard-earned money for a vanity project that

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[323] Joanne Dahme, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 19 Jul 2021; Joan Becker, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.
[324] C. Drew Brown, Public Education Manager, telephone interviews with author-editor, 30 Jun 2021, 8 Jul 2021, 7 Jun 2022; Joan Becker, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 9 Jul 2022.

would benefit only a few.[325]

Becker gave the responsibility for the overall development of the Interpretive Center to Public Education Manager Brown. By the end of the year, Brown had attracted funding from the National Oceanic and Atmospheric Administration's Coastal Zone Management Program[326] and began interacting with the community at an advertised public meeting about the Water Department's intention to construct an interpretive center at Fairmount.[327]

Brown and the Public Affairs team developed an initial vision of what the interpretive center could be and in early 1985 issued a request for qualifications for architectural firms interested in providing guidance. Shortly after, the Water Department selected Matheu Cebul & Associates.[328]

Partners Christine Matheu and Mary-Scott Cebul had experience in the areas the Public Affairs team was looking for. Matheu had worked for the renowned architect Robert Venturi at Venturi, Rauch, and Scott Brown.[329] Cebul's background was in anthropology, specifically primate psychology;[330] she had been the planning and project management consultant at the Philadelphia Zoo. The pair had most recently worked together on the award-winning Children's Tree House at the zoo.[331] For approximately a year, Matheu and Cebul worked with Brown, Becker, and the Public Affairs team, as well as with numerous consulting architects, engineers,

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[325] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021.
[326] Authorized by the Coastal Zone Management Act of 1972, the National Coastal Zone Management Program is designed to assist coastal and Great Lakes states and territories in "protecting, restoring, and responsibly developing [their] diverse coastal communities and resources." See "The National Coast Zone Management Program," *Office for Coastal Management, National Oceanic and Atmospheric Administration* (20 May 2022), <https://coast/noaa/gov/czm/>, accessed 20 May 2022.
[327] C. Drew Brown, "Public Notice," *Philadelphia Daily News* (2 Dec 1985), 38.
[328] Christine Matheu, Principal, Matheu Architects, PC, telephone interview with author-editor, 28 Jul 2022.
[329] This was the name of Venturi's firm from 1980 to 1989.
[330] Cebul had learned, perhaps unsurprisingly, that this transfers well to human behavior.
[331] "Philadelphia Zoo, George D. Widener Memorial Tree House and New Children's Zoo," *VSBA* (2022), <www.vsba.com/projects/philadelphia-zoo-george-d-widener-memorial-tree-house-and-new-childrens-zoo/>, accessed 28 Jul 2022.

and historians to craft a professional concept.[332]

Matheu Cebul's landmark report, completed in June 1986, identified the central theme: "a celebration of water."[333] In support of this theme were two educational purposes—historical and environmental. The historical element would "allow people of all ages to become reacquainted with the importance of the Waterworks [*sic*] in the development of the city."[334] The environmental element would "draw attention to the entire Schuylkill River Coastal Zone and remind Philadelphians of the importance of this waterfront in the overall ecology of the region."[335]

The report also explored the contextual fabric within which an interpretive center would need to operate. Matheu and Cebul determined that the needs of historic preservation should be served, a commercial function such as a restaurant would most likely be operating from the Engine House and could defray maintenance costs, and the surrounding grounds would need to be refurbished in such a way as to provide recreational links to other portions of Fairmount Park, the Philadelphia Museum of Art, and the Schuylkill River Park being developed downstream of Fairmount.[336] The concept was shown to the public at a well-received presentation at the Art Museum in February of 1987.[337]

Envisioned was a space within the Old Mill House and the lower level of the Engine House, accessed by a new double stairway inside the South Entrance House, filled with

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[332] Matheu Cebul & Associates, Design for an Interpretive Center at the Fairmount Waterworks: Final Report (30 Jun 1986); Christine Matheu, Principal, Matheu Architects, PC, telephone interview with author-editor, 28 Jul 2022.
[333] Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 5.
[334] Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 2.
[335] Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 2.
[336] Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 2.
[337] Thomas Hine, "In Celebration of Water," *Philadelphia Inquirer* (19 Feb 1987), 1D, 8D.

interactive exhibits designed to demonstrate how the Water Works once operated and show the importance of clean water. The remaining Jonval turbine would be preserved and highlighted. There would be a water-driven replica of one of the original breast wheels that would pump water to a drinking fountain. At the time, an excavated Forebay was considered highly desirable, perhaps even necessary to the proper interpretation of the site, and was included in the plan.[338] The center was designed to appeal to adults and children alike. Since the space was below the floodplain, the exhibits would be constructed of materials designed to withstand flooding.[339]

The concept outlined in the report would serve as an overarching guide for the development and ultimate creation of the Interpretive Center for the next 17 years.[340] In 1986 the cost for fit-out of the facility alone was estimated to be a little over $1.7 million.[341] This did not include the cost of the design, fabrication, and installation of any of the exhibits, nor the furnishing of any onsite staff offices.[342]

In response to a request by Water Commissioner Marrazzo in October 1988,[343] the Fairmount Park Commission a month later gave permission to the Water Department to create and operate a "Water Resources Institute" within the Old Mill House and New Mill House.[344] Designed for flexibility, the concept allowed for a training function for high school students and

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338 See Marianna Thomas Architects, *Fairmount Water Works Forebay Feasibility Study* (1990) for further discussion of the rationale for excavating the Forebay. Unfortunately, this feature was later dropped from consideration.

339 Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 14f; Thomas Hine, "In Celebration of Water," *Philadelphia Inquirer* (19 Feb 1987), 1D, 8D.

340 Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Final Report* (30 Jun 1986), 7ff. It is remarkable the degree to which today's Interpretive Center adheres to the concept initially developed by Matheu Cebul and the Water Department's Public Affairs team.

341 The equivalent of approximately $4.6 million in 2022.

342 Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Appendix to Final Report,* Section E, Building Cost Estimate (30 Jun 1986).

343 William J. Marrazzo, Commissioner, Philadelphia Water Department, to F. Eugene Dixon, Jr., President, Fairmount Park Commission, 12 Oct 1988.

344 Doti Buckley, Secretary, Fairmount Park Commission, to William J. Marrazzo, Commissioner, Philadelphia Water Department, 18 Nov 1988; Doti Buckley, Secretary, Fairmount Park Commission, to Katherine Huseman, Esq., Counsel to the Fairmount Park Commission, 18 Nov 1988.

Water Department employees, a research center, an environmental observation site, and a public education center.[345] This agreement is the formal basis upon which the Water Department operates the Interpretive Center at Fairmount to this day.

No matter the final shape the interpretive center would take, it would need someone to run it. Becker asked Brown to create the director's position, with the director reporting to him. Soon afterward, in December 1988, Brown hired Edward F. Grusheski (2 May 1946–23 Dec 2020) to serve as Director of the Fairmount Water Works Interpretive Center.[346]

A native of Boston, Ed Grusheski had earned a Bachelor's degree from Georgetown University in Washington, D.C. and a Master of Arts in American Civilization from the University of Pennsylvania in Philadelphia. He had been a curator and educator at the Boston Children's Museum, the New Jersey State Museum in Trenton, and the Civic Center Museum and Independence Seaport Museum (called the Port of History Museum at the time), both in Philadelphia. He served on the boards of the Global Water Alliance and the Fund for the Water Works, on the planning committee of the Partnership for the Delaware Estuary, and as president of the Oliver Evans Chapter of the Society for Industrial Archeology.[347] An energetic person, Grusheski had a knack for sharing the things that fascinated him. His was the classic "infectious enthusiasm." The successful creation of the Fairmount Water Works Interpretive Center became Grusheski's passion for the rest of his life.

The Junior League in 1989 created an "Interpretive Center at the Fairmount Water Works" committee with the purpose of creating in informational brochure. The project expanded

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[345] Philadelphia Water Department, *A Proposal for a Water Resources Institute* (Aug 1988), 2f.

[346] Becker had met Grusheski at a cocktail party and after speaking with him at length decided to interview him for the job. C. Drew Brown, Public Education Manager, telephone interviews with author-editor, 30 Jun 2021, 8 Jul 2021, 7 Jun 2022.

[347] Thomas Fitzgerald, "Edward Grusheski, 74, Enthusiast of Waterworks Site," *Philadelphia Inquirer* (11 Jan 2021), B4.

from a simple promotional piece to a companion for a self-guided walking tour of the Fairmount complex, including a map, a description and history of the various buildings and landscape features, a brief summary of the Junior League's involvement, and a tear-off invitation to join a group called the Friends of the Interpretive Center. It was envisioned that the Junior League would not continue in its current role forever, and a community-based Friends group could step up when the time came for the Junior League to relinquish its direct involvement.[348] In 1991 and 1992, volunteers from this group sponsored several clean-up and gardening projects for the grounds of Fairmount.[349]

Brown and Grusheski organized activities devised to elevate public awareness of Fairmount and the developing interpretive center. In 1990, for example, a display of selected historical photographs from the Water Department's collection was exhibited in the Watering Committee Building daily throughout the summer.[350] Some years the Water Department coordinated with the Fairmount Park Commission to host events called Water Works Weekends. Doubling as fundraiser events, they featured food and live jazz and classical music on the decks of the Old and New Mill Houses.[351] Guided tours through the buildings of Fairmount, begun as early as 1984, were continued through the 1990s.[352] Fun educational programs were devised. In 1996 alone, for example, ten thousand visitors, consisting mostly of school groups, participated

[348] Junior League of Philadelphia, *1992 Annual Report* (Summer 1992), D-5; Junior League of Philadelphia, *1993 Annual Report* (Summer 1993), D-4.
[349] Fairmount Park Commission, *1991–92 Annual Report* (Jun 1992), 6.
[350] "Water Department Displays Turn-of-the-Century Photos," *Philadelphia Inquirer* (9 Jul 1990), 10; "A Generous Supply of Pure Water," *Philadelphia Daily News* (16 Jul 1990), 11; Larry Copeland, "Exhibit Offers Portrait of City a Century Ago," *Philadelphia Inquirer* (26 Jul 1990), 1Bf.
[351] For example "Water Works Weekend," *Philadelphia Daily News* (30 Oct 1992), 109.
[352] For example "Fairmount Water Works," *Philadelphia Inquirer* (3 Nov 1984), 103; "Fairmount Water Works," *Philadelphia Inquirer* (15 Feb 1985), 136; Tours, Historic Buildings: Fairmount Waterworks," *Philadelphia Inquirer* (27 Dec 1985), 97; "Tours, New This Week: Fairmount Waterworks," *Philadelphia Inquirer* (10 Jan 1986), 78; "Tours of the Renovated Fairmount Water Works," *Philadelphia Daily News* (16 Apr 1990), 20; Clark DeLeon, "The Scene: One of the Most Enduring Symbols," *Philadelphia Inquirer* (8 Nov 1991), 2; "Fairmount Waterworks Walking Tour," *Philadelphia Inquirer* (24 Sep 1993), 120; "Tours: See the Water Works," *Philadelphia Daily News* (14 Sep 1995), 16; "Fairmount Water Works to Begin Summer Tours," *Philadelphia Inquirer* (1 Jun 1996), 12.

in Interpretive Center activities at Fairmount.[353] Grusheski also took his show on the road, making off-site presentations about the planned interpretive center to any receptive group across the city.[354]

Commissioner Marrazzo left the Water Department in 1988 to lead a large environmental services corporation[355] and Mayor Wilson Goode appointed John Plonski to replace him.[356] In 1994 Joan Becker departed to work for Marrazzo and Plonski promoted Joanne Dahme to the position of General Manager of Public Affairs.[357]

Dahme was very supportive of the development of the Interpretive Center. When she left the Water Department in the fall of 1998 to pursue a master's degree in creative writing at the University of Pennsylvania, Water Commissioner Kumar Kishinchand[358] promoted Grusheski to replace her.[359]

For a little over a year, Grusheski wore two hats—General Manager of Public Affairs and Director of the Interpretive Center. It quickly became clear, however, that a full-time Director would need to be hired. The position was advertised in November 1999[360] and interviews were conducted in December. In January 2000, Grusheski hired Gail Tomlinson to replace him as Director of the Interpretive Center.[361] For approximately two years, Tomlinson reported to Public

[353] Ron Avery, "Generating a Cash Flow," *Philadelphia Daily News* (11 Nov 1997), 8.
[354] For example Earni Young, "You're Cordially Invited to Center City's Open House," *Philadelphia Daily News* (16 Oct 1992), 73; "Friends of Pennypack Park," *Philadelphia Daily News* (17 Jun 1993), 117; "Schuylkill Center for Environmental Education," *Philadelphia Inquirer* (22 Jan 1999), 169.
[355] Weston Solutions, Inc., in nearby West Chester, Pennsylvania.
[356] Plonski would serve as Water Commissioner until the end of Mayor Goode's term of office in January 1992.
[357] Joanne Dahme, former General Manager, Public Affairs, Philadelphia Water Department, telephone conversation with author-editor, 19 Jul 2021.
[358] Kishinchand had been appointed Water Commissioner by newly elected Mayor Edward G. Rendell in January 1992.
[359] Joanne Dahme would return to the position of General Manager of Public Affairs upon Ed Grusheski's retirement in 2009.
[360] "Waterworks Interpretive Center Director," *Philadelphia Inquirer* (14 Nov 1999), 146.
[361] Gail Tomlinson, former Director, Fairmount Water Works Interpretive Center, personal interview with author-editor, 7 Jul 2022.

Education Manager Brown; thereafter she reported directly to Grusheski.

Tomlinson had a background in public special education and had worked in the historical museum field. She had first met Grusheski years earlier when he was promoting the Philadelphia Civic Center Museum and she was serving as chair of the Education Committee for the Museum Council of Philadelphia. She had also informally worked with both Grusheski and Brown while working for the nonprofit Fairmount Park Council, a loose association of women's groups that were helping to manage the historic houses in Fairmount Park.[362]

In June 2000, the Fund for the Water Works Interpretive Center received a $1.1 million challenge grant[363] from the William Penn Foundation for the interpretive center.[364] As donations were received, the Foundation would match them, dollar for dollar, up to the specified amount. Three months later, the Delaware River Port Authority contributed $1 million.[365] This funding allowed final design and construction of the interpretive center to get under way. Steve Feldman Associates was hired to provide overall management of the design and eventual installation of the exhibits. The Water Department expected to open the Interpretive Center by the summer of 2002.[366]

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[362] Gail Tomlinson, former Director, Fairmount Water Works Interpretive Center, personal interview with author-editor, 7 Jul 2022.
[363] The equivalent of approximately $1.9 million in 2022.
[364] *Fund for the Water Works' Interpretive Center, Monthly Treasurer's Report, Statement of Receipts and Disbursements* (Dec 2018); "Fairmount Water Works to Get Grant for Education Center," *Philadelphia Inquirer* (27 Jun 2000), 14; "$1M for Education," *Philadelphia Daily News* (29 Jun 2000), 10.
[365] Dwight Ott, "DRPA Approves Funding for Projects," *Philadelphia Inquirer* (21 Sep 2000), 12. The amount is the equivalent of approximately $1.7 million in 2022.
[366] Elisa Ung, "Rebuilt Water Works' Debut Is On the Horizon," *Philadelphia Inquirer* (10 Jan 2001), A1, A8; "The Tide Turns [editorial]," *Philadelphia Inquirer* (17 May 2001), 20.

While the development of the Interpretive Center moved closer to reality, planning for a restaurant had been inching forward as well.

A restaurant at Fairmount is one of those things that always seems to have been on people's minds. Dining amid interesting surroundings is an enjoyable pastime for many. Add a nice view, perhaps some outdoor seating, and you've got the makings of a great location for a restaurant. The Fairmount Water Works checks all of these boxes. In fact, Fairmount has long been associated with food. Refreshments, including ice cream, were served in the Engine House throughout the 19th century. Although food was not offered during the Aquarium years, some sort of refreshments service had been planned in the early 1950s but never implemented. From the summer of 1977 to the spring of 1982, as we have seen, the popular Water Works Café offered light meals *al fresco* on the deck of the Engine House during the warmer months. Beginning in the fall of 1980, the service moved indoors as well and operated year-round, with live music featured on selected evenings. The 1982 fire in the Engine House, however, necessitated repairs too costly for the operators at the time and the Café was shuttered for good.

Recall that the Fairmount Park Commission and Philadelphia Water Department had in 1984 issued joint request for qualifications both for potential operators of a hydroelectric plant and potential operators of a restaurant. While six plant operators expressed interest, six restaurateurs did the same. Five years later the Fairmount Park Commission issued a request for proposals for "the development of a full menu table service restaurant of 256 seats" and "rehabilitation" of the interior of the Engine House.[367] This would require a substantial investment by any interested party. The only response was from the corporation that ran The Chart House, a chain of upscale seafood restaurants, one of which was located at Penn's Landing

[367] "Request for Proposals: Fairmount Water Works," *Philadelphia Inquirer* (15 Mar 1989), 64.

on the Delaware River.[368]

The Chart House proposal raised a few eyebrows. The design called for utilizing the interior of the Old Mill House for the main dining area, rather than the Engine House where a bar would be located instead. The North and South Entrance Houses would be used as skylights. Perhaps most troubling, additional seating would be located within a glassed-in Pavilion and a stairwell would be cut through the Old Mill House deck for access to the Pavilion dining area from below.

There were also worries that with such a sprawling operation, the restaurant would simply dominate the site. Too much of the Fairmount Water Works buildings would be cut off from the public. An interpretive center, still in the initial planning stage, would be confined to the lower level of the Engine House and relegated to a waiting area for the restaurant. Although Chart House planners said glassing in the Pavilion was essential to making the plan financially viable, concerns were raised that combined with additional outdoor seating across the deck of the Old Mill House, a great public space was being privatized and public access would be eliminated.

Others pointed out that since the Chart House was the only party interested, it was either their plan or nothing at all. Besides, they had experience operating sensitively and successfully in historic settings elsewhere.[369] Ed Bacon, the well-known urban planner, weighed in on the proposal, urging its adoption at all possible speed. "Empty buildings cause blight and decay," he reminded everyone, and called concerns over the less-than-highest use of public space

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[368] Leonard W. Boasberg, "Waterworks Restoration Moves Into Phase Three," *Philadelphia Inquirer* (20 Jul 1989), 30.

[369] "Rescue by Restaurant [editorial]," *Philadelphia Inquirer* (16 Apr 1990), 10A.

"unabridged rubbish."[370]

Without using such broad swaths of the site, the Chart House financial executives decided they "couldn't make the numbers work," as Fairmount Park Commission Executive Director William E. (Bill) Mifflin later put it,[371] and the proposal fell apart. By the spring of 1992 the Commission was actively soliciting proposals once again.[372]

In 1992 the City of Philadelphia and Commonwealth of Pennsylvania each contributed $2 million[373] toward the renovation of the interior of the Engine House, with the goal of enabling the building to accommodate a full-service restaurant. Work finally got under way in the spring of 1998.[374]

The central room was prepared for use as the main dining room. A kitchen was created within the main and lower levels of the South Boiler Shed. The North Boiler Shed[375] would serve as the main entrance to the restaurant, as it did for the Aquarium, but instead of the entrance leading directly down to the lower level as it did during the Aquarium's later years, it would now lead guests straight through to a reception and waiting area on the main level where they would wait to be seated in the central room or on the riverside deck.

The concrete stairway, left over from the Aquarium years, was jackhammered out and replaced with a new stairway and an elevator. The stair and elevator led to the lower level where

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[370] Edmund N. Bacon, "Don't Muck Up the Water Works Plan [letter to editor]," *Philadelphia Inquirer* (13 Apr 1990), 12.
[371] William E. Mifflin, former Executive Director, Fairmount Park Commission, telephone interview with author-editor, 18 Aug 2021.
[372] William E. Mifflin, Executive Director, Fairmount Park Commission, "The City of Philadelphia is soliciting proposals…," *Philadelphia Inquirer* (29 May 1992), 109.
[373] The equivalent of approximately $4.2 million in 2022.
[374] Fairmount Park Commission, *1997–98 Annual Report* (Jun 1998), 2, 10; *The Water Works, Philadelphia* (Fairmount Park Commission, 8 Sep 2001).
[375] Recall that the North and South Boiler Sheds are the one-story structures on the north and south sides of the Engine House that, together with the cellar spaces beneath them, housed the boilers for the steam engines that operated in the large central space of the Engine House from 1815 to 1822, prior to the construction of the Old Mill House and the conversion of the Fairmount Water Works from steam power to water power.

new restrooms were located. The stairway would also serve as one of the emergency exits for the Interpretive Center. The central HVAC system and the controls for the utilities were installed on the second floor, above the central room. Since the second floor space was rather cramped, additional ductwork was installed above it, on the roof truss level.[376]

While replacing the floor of the central room, the tops of two long, narrow, vertical voids in the masonry were exposed, one each in the northwest and southwest corners. Extending down below the floorboards, these were likely pockets that had accommodated the momentum wheels for the north and south steam engines.[377] When the new floor was installed, they were both preserved beneath it.

Construction within the lower level of the South Boiler Shed revealed the foundation of the boiler for the south engine. This historic structure was unfortunately destroyed, however, during the process of creating the kitchen area.[378]

In 1998, despite public protests over the monopolization of concessions and concerns about driving small operators out of business,[379] a company called Fairmount Park Management[380] was awarded a contract for all food concessions, large and small, within the

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[376] Mark B. Thompson Associates, *Fairmount Water Works: Engine House Restoration,* schematic plans (26 Jul 1996).

[377] *Photographic record,* Fairmount Park Historic Resource Archives: *Water Works Engine House Restoration, Feb–June 1998* (photographic binder), Images 30707-35, 30707-36, 30707-37, and 30707-38. The south steam engine, recall, had operated there from 1815 to 1822 and the north steam engine from 1816 to 1822.

[378] *Photographic record,* Fairmount Park Historic Resource Archives: *Water Works Engine House Restoration, Feb–June 1998* (photographic binder), Images 30724-08, 30724-12, 30724-13, 30724-14, 30724-15, 30724-16, 30739-13, and 30739-14.

[379] April Adamson, "Venerable Vendor Vies with $107 Million, 10-Year Deal," *Philadelphia Daily News* (28 Jul 1998), 3; April Adamson, "Kelly Drive Vendor Wins Over New Conglomerate Concessionaire," *Philadelphia Daily News* (28 Jul 1998), 3, 13; W. Russell G. Byers, "How About Rest of Us?" *Philadelphia Daily News* (28 Jul 1998), 3, 13.

[380] Co-owned by James Israel and Judith Nilon. See Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B10.

Fairmount Park system.[381] Over the ten-year period of the agreement, the company was projected to earn a profit of approximately $107 million.[382] Since the contract called for 12.4 percent of the profit to be paid to the Fairmount Park Commission, that meant over $13.2 million[383] for the park system's funding.[384] More importantly for Fairmount, the operator of the enterprise was delegated the responsibility of deciding who would run any restaurant there.[385]

The Fairmount Park Commission announced in January 2001 that the exterior restoration of Fairmount's buildings was nearing completion and it anticipated removing the fencing surrounding the site and reopening the decks and grounds to the public sometime in June. It was hoped that a restaurant would be operating by that time as well.[386] By March, delays in improving the roadway access from Kelly Drive[387] had pushed the projected opening back to September.[388]

The Junior League of Philadelphia handed off the Water Works Restoration Committee and its fundraising activities to the Preservation Alliance of Greater Philadelphia at this time. Still led by Susan Myers, the committee designated some of the remaining monies toward a handful of projects, including $10,000[389] for the replacement of the missing eagle atop the Eagle

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[381] Fairmount Park Commission, *Request for Proposals for the Development, Operation, and Management of Food, Non-Alcoholic Beverage, Merchandise and Rental Concessions, and Banquet Facilities in Fairmount Park* (22 May 1996).
[382] The equivalent of approximately $194 million in 2022.
[383] The equivalent of approximately $24 million in 2022.
[384] April Adamson, "Venerable Vendor Vies with $107 Million, 10-Year Deal," *Philadelphia Daily News* (28 Jul 1998), 3; Dave Davies, "New Vendors, New Image for Park?" *Philadelphia Daily News* (5 Aug 1988), 6, 61; Dave Davies, "Vending Plan," *Philadelphia Daily News* (5 Aug 1998), 61. The period was extendable to 20 years, at the pleasure of the Fairmount Park Commission. The award was the key component of a plan to extricate the Commission's staff from the job of directly managing food concessions and catering operations within its jurisdiction, something it was ill-equipped to do.
[385] Jon McCalla, "Water Works in the Works," *Philadelphia Business Journal* (24 Apr 2000), <www.bizjournals.com/philadelphia/stories/2000/04/24/story7.html>, accessed 6 Jun 2022.
[386] Elisa Ung, "Rebuilt Water Works' Debut Is On the Horizon," *Philadelphia Inquirer* (10 Jan 2001), A1, A8.
[387] East River Drive had been renamed Kelly Drive in 1985.
[388] Elisa Ung, "Fairmount Water Works to Reopen Sept. 8," *Philadelphia Inquirer* (10 Jan 2001), 24.
[389] The equivalent of approximately $16,700 in 2022.

Pavilion and $35,000[390] for the restoration of the Graff Memorial in the South Garden.[391] On 29 June 2001 a gilded bronze eagle[392] was installed atop the Eagle Pavilion and a celebratory ceremony was held the same day.[393]

By the end of August 2001, the restoration of the exterior of the Fairmount Water Works was finally completed.[394] Although work on the interior renovation of the Engine House for a restaurant continued, a gala celebration was held at the Water Works on the evening of Saturday 8 Sep 2001. Officially, 900 attended,[395] but in reality a great deal more showed up. So many had contributed so much to Fairmount's restoration over the years and had anticipated this night for so long, they couldn't help but come to celebrate. People filtered in all evening.

Light refreshments, sparkling cocktails, and jubilant remarks were served. The weather was clear and for a while the reflection of a brilliant sunset seemed to set the river itself ablaze before the orange sky gave way to hues of teal, deep blue, then inky black. The mood was elated and optimistic. Coming as it did on the last Saturday before the horrific events of 9/11, it was remembered later as a "magical evening."[396]

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390 The equivalent of approximately $58,500 in 2022.
391 "Susan Wiener Myers," *Monaghan Funeral Home* (unknown date), <http://www.monaghanfuneralhome.com/obituaries/print?o_id=4856781>, accessed 16 Aug 2021.
392 Email from Theresa Stuhlman to A. Leonard Pundt, 24 Aug 2021.
393 *Photographic record,* Fairmount Park Historic Resource Archives.
394 *Photographic record,* Fairmount Park Historic Resource Archives.
395 Pauline Pinard Bogaert, "Old Wonder on the Schuylkill," *Philadelphia Inquirer* (11 Sep 2001), 40.
396 Marilyn Sprague, Sustainer Member, Junior League of Philadelphia, telephone interview with author-editor, 30 Oct 2021.

CHAPTER 14

RENAISSANCE

On New Year's Day, 2002, four months after the completion of the exterior restoration was feted, something happened which left everyone involved reeling. At 10:02 in the morning, a fire broke out in the Engine House. For two and a half hours, while smoke poured from the second- and third-floor windows and 56 fire fighters worked to control the blaze, no one knew how bad it was. For a long dreadful moment, it looked as if all of the history and hard work would come crashing down in a shower of sparks and burning timbers.[1]

To those who had worked so hard to bring life back to Fairmount, it was, in the words of the editorial board of the *Philadelphia Daily News*, like "a punch in the solar plexus."[2] Rushing to the scene, a teary-eyed Fairmount Park Commission Executive Director Bill Mifflin lamented, "This is one of the worst days of my life. It's been like our baby."[3] Stephanie Craighead, Fairmount Park Commission Deputy Director for Planning called the fire "worse than distressing" and said she felt like she was "the one on fire."[4]

Deputy Fire Commissioner Captain John McGrath characterized the damage as "fairly extensive."[5] Repairs were initially estimated to cost approximately $1.2 million.[6] Within two days, however, closer inspection revealed that the damage was not as pervasive as had originally

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[1] Thomas Ginsberg, "Blaze Hits Historic Landmark Along River," *Philadelphia Inquirer* (2 Jan 2002), A1, A6; Earni Young, "Fire Damages Historic Engine House," *Philadelphia Daily News* (2 Jan 2002), 4.
[2] "Fire and Water [editorial]," *Philadelphia Daily News* (3 Jan 2002), 17.
[3] Thomas Ginsberg, "Blaze Hits Historic Landmark Along River," *Philadelphia Inquirer* (2 Jan 2002), A1, A6. Mifflin later said of that day, "It was the most sickening feeling, the worst day of my professional life." See Art Carey, "The Park is His Turf," *Philadelphia Inquirer* (21 Mar 2002), D1, D5.
[4] Thomas Ginsberg, "Blaze Hits Historic Landmark Along River," *Philadelphia Inquirer* (2 Jan 2002), A1, A6.
[5] Thomas Ginsberg, "Blaze Hits Historic Landmark Along River," *Philadelphia Inquirer* (2 Jan 2002), A1, A6.
[6] Earni Young, "Engineers to Eye Damage to Engine House," *Philadelphia Daily News* (3 Jan 2002), 7f. The amount was the equivalent of approximately $2 million in 2022.

been feared. The fire had been confined to the space between the 35-foot-high vaulted ceiling of the main floor's central room and the floorboards of the second level. Much of the damage consisted of windows and doors smashed during efforts to get at the fire and water damage from the sprinkler system and fire fighters' hoses.[7] Some beams had suffered surface charring, and many joists would need to be replaced, but "otherwise the building is really in good shape," remarked architect Mark Thompson, who had long worked on plans for the adaptive reuse of Fairmount.[8] Barry Bessler, Fairmount Park Commission Chief of Staff, was relieved. "It could have been a lot worse," he acknowledged.[9] A more modest repair bill of $500,000 was envisioned.[10]

In the midst of an uncertain outlook, those involved quickly expressed a firm resolve to fix the damage and forge ahead. "A building like this will not go derelict. It will be restored," declared Mifflin.[11] Fairmount Park Commissioner Ernesta Ballard, who had been working to raise funds for Fairmount since 1992, vowed, "It will be repaired, believe me. This is a little detour in the road. This is a building and a facility that will not die."[12] "We've been through so much," affirmed Ed Grusheski, General Manager of Public Affairs for the Water Department. "There's a lot of spirit behind this project. We'll see it through."[13]

How the repairs would be paid for was an open question, however. There would be no

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[7] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11; Earni Young, "Engineers to Eye Damage to Engine House," *Philadelphia Daily News* (3 Jan 2002), 7f

[8] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11

[9] Earni Young, "Engineers to Eye Damage to Engine House," *Philadelphia Daily News* (3 Jan 2002), 7f. When the author-editor accessed the roof truss level in 2016 in order to document and photograph the historic workers' graffiti, he found it to be virtually untouched. See A. Leonard Pundt, *Fairmount Water Works Engine House Roof Truss Level: Photographic Documentation of Historic Workers' Graffiti* (Philadelphia: 13 May 2016).

[10] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11; Earni Young, "Engineers to Eye Damage to Engine House," *Philadelphia Daily News* (3 Jan 2002), 7f. The amount was the equivalent of approximately $823,000 in 2022.

[11] Thomas Ginsberg, "Blaze Hits Historic Landmark Along River," *Philadelphia Inquirer* (2 Jan 2002), A1, A6.

[12] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11.

[13] "Don't Give Up [editorial]," *Philadelphia Inquirer* (3 Jan 2002), A14

insurance proceeds because the Fairmount Water Works is owned by the City of Philadelphia which is self-insured.[14] Donors, both private and public, who had provided so much already, would likely be reluctant to give toward the cost of recovery, especially if negligence were involved.[15] If one or more contractors were determined to be negligent, though, some or all of the costs might be recovered. City Managing Director Estelle Richman declared that even if no contractor were found to be at fault, repairs would be financed directly out of taxpayer revenues.[16]

The cause of the fire was determined to be overloaded electrical wiring which had caused a foot-thick beam to smolder for several hours before it burst into flames and generated enough smoke to activate an alarm.[17] Speculative suspicion first fell upon the electrical contractor, Goldhorn Inc. of Clifton Heights, Pennsylvania. Owner Jim Goldhorn protested that his company had indeed installed the electrical system as well as the fire alarm system—which, he reminded observers, had worked as intended—but had not worked on the project for about two years. Additional electrical and other work, he pointed out, had since been done by others.[18]

Indeed it had and Goldhorn's work was eventually cleared. Inspectors later determined that most of the fault lay with contractor Edward J. Meloney, Inc, of Lansdowne, Pennsylvania, whose workers had improperly installed the HVAC system's boilers.[19] In July of 2005 a jury in a civil trial awarded the City of Philadelphia $1.3 million in damages.[20] The City had earlier

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[14] Earni Young, "Fire Damages Historic Engine House," *Philadelphia Daily News* (2 Jan 2002), 4; Stephan Salisbury, "Restoration Plans Tapped Out for Now," *Philadelphia Inquirer* (28 Jul 2005), B1, B4.
[15] Stephan Salisbury, "Restoration Plans Tapped Out for Now," *Philadelphia Inquirer* (28 Jul 2005), B1, B4.
[16] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11.
[17] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11.
[18] Cynthia Burton, "Hope Flows for Historic Water Plant," *Philadelphia Inquirer* (3 Jan 2002), A1, A11.
[19] Most of the HVAC system, including the boilers, was located on the second floor of the Engine House. Additional components were installed on the roof truss level (one level above).
[20] The equivalent of approximately $2 million in 2022.

settled out of court with the consulting architect, consulting engineer, and sprinkler contractor.[21]

Although the City eventually recovered full monetary damages, procedural difficulties in the meantime prevented quick repair. It was originally hoped that reconstruction would be accomplished in a matter of weeks;[22] in March, a December target for the opening of the restaurant was still thought to be viable.[23] With no movement by the middle of August, however, that notion was now dead. With six months of anticipated repair work, followed by the completion and fitting out of the restaurant facility, a public opening could not happen before the spring of 2003.[24]

Two questions were slowing things down. First, did Pennsylvania state law require the city to follow the usual time-consuming process of obtaining four construction bids, evaluating the bids, and selecting the best, or could the City justify an emergency situation which would allow it to follow a speedier, streamlined process? Second, should the City try to recover monetary damages from one or more contractors before spending money on the repairs? Once the repairs were paid for, it would be much more difficult to obtain compensation from a contractor.[25]

Bill Marrazzo, who had been involved in Fairmount's restoration since his days as Water Commissioner in the 1980s, confirmed that the issues were no joke. "From my point of view, I just want to see the thing finished," he was quoted as saying, but the legal uncertainties are "serious and real."[26] Nevertheless, some of the people involved were becoming concerned. "If it isn't opened to the public soon, with proper maintenance," Ernesta Ballard worried, "it's just

[21] Stephan Salisbury, "City Wins $1.3 million in Water Works Fire Case," *Philadelphia Inquirer* (6 Jul 2005), B3.
[22] Stephan Salisbury, "Restoration Plans Tapped Out for Now," *Philadelphia Inquirer* (28 Jul 2005), B1, B4.
[23] Art Carey, "The Park is His Turf," *Philadelphia Inquirer* (21 Mar 2002), D1, D5.
[24] Ramona Smith, "Waterworks' Future Uncertain," *Philadelphia Daily News* (15 Aug 2002), 8, 31.
[25] Ramona Smith, "Waterworks' Future Uncertain," *Philadelphia Daily News* (15 Aug 2002), 8, 31.
[26] Ramona Smith, "Waterworks' Future Uncertain," *Philadelphia Daily News* (15 Aug 2002), 8, 31. Marrazzo was at the time (and still is at the time of this writing) CEO of WHYY, the local public television station.

going to start deteriorating again. It's inevitable."[27] It didn't help that City officials had clammed up. There was no word from Mayor John Street and members of the administration directed all questions to Managing Director Richman, who had delayed responding to inquiries.[28]

The estimated cost of the repairs grew to $750,000,[29] but this was still less than originally feared. The editorial board of the *Philadelphia Inquirer* urged the City to just "front the money" and get it done.[30] In early October the Fairmount Park Commission decided the best way to get the work done was to allow the Fairmount Park Historic Preservation Trust to lease the Engine House from the City and manage the repair project itself, since the organization was not constrained by the same regulations.[31] Work finally began shortly afterward, over nine months after the fire.[32]

Two months into the work there was another scare. At 26 minutes after three o'clock on the afternoon of Wednesday 11 December, there was another fire in the space between the vaulted ceiling and the second-story floorboards, the same area in which the earlier fire had occurred. This time it was caused by the restoration contractors allowing an extremely hot halogen light to get too close to a wood joist. Although the fire alarm was tripped and fire fighters did respond, the workers had quickly dowsed the flames with fire extinguishers and there was no real damage. The progress of the work was not affected;[33] it was completed in early 2003.[34]

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[27] Ramona Smith, "Waterworks' Future Uncertain," *Philadelphia Daily News* (15 Aug 2002), 8, 31
[28] Ramona Smith, "Waterworks' Future Uncertain," *Philadelphia Daily News* (15 Aug 2002), 8, 31.
[29] Art Carey, "The Park is His Turf," *Philadelphia Inquirer* (21 Mar 2002), D1, D5; Stephan Salisbury, "Restoration Plans Tapped Out for Now," *Philadelphia Inquirer* (28 Jul 2005), B1, B4. The amount was the equivalent of approximately $1.2 million in 2022.
[30] "Clear Path [editorial]," *Philadelphia Inquirer* (3 Aug 2002), A6.
[31] Stephan Salisbury, "No Stroll In the Park," *Philadelphia Inquirer* (15 Oct 2005), B1, B3.
[32] Ramona Smith, "Fire Hits Waterworks—Again," *Philadelphia Daily News* (12 Dec 2002), 8.
[33] Ramona Smith, "Fire Hits Waterworks—Again," *Philadelphia Daily News* (12 Dec 2002), 8.
[34] *Photographic record,* Fairmount Park Historic Resource Archives.

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While the Engine House fire demanded much attention, mainly from the staff of the Fairmount Park Commission, planning continued at the Water Department for the Interpretive Center. While Ed Grusheski was now the Water Department's General Manager of Public Affairs, and Gail Tomlinson was Director of the Interpretive Center, it was primarily Grusheski's vision that guided the center's development. As had been planned since its initial conception, Fairmount's history would be an integral element but the main purpose of the Interpretive Center would be to demonstrate the importance of clean water, showcase the Water Department's role in providing it to the people of Philadelphia, and encourage visitors to partner with the Department in protecting the water supply.

Grusheski had been working with Mark B. Thompson Associates to develop an overall concept.[35] Mark Thompson subcontracted with Steve Feldman Design to plan the exhibits. Feldman, a local Philadelphian, created an overview of what the visitor's experience might be, what kind of exhibits there could be, and where exhibits might be located. Feldman also developed an initial visual and graphical theme. While awaiting further funding, the stakeholders considered the concepts.

Grusheski liked what Feldman had designed and invited him to develop a detailed overall design, directly for the Water Department. Working with Thompson now, instead of for him, Feldman completed the design in approximately a year and a half. Feldman conferred closely

[35] Mark B. Thompson Associates, *Fairmount Water Works Interpretive Center: Preliminary Design Submittal* (23 Jan 1996). A student, then colleague, of architect Louis Kahn, Thompson's work has focused on the successful adaptive reuse and re-activation of historic properties.

with Grusheski and Tomlinson and created a plan for visitors to experience the space. He determined what messages would be conveyed by each exhibit and activity, determined what each activity would look and feel like, and decided where each exhibit would go. Katie Bolanger, Feldman's graphic designer, helped create an overall impression of fun without being overly juvenile. There would be serious messaging, but it would all be wrapped in a sense of play.[36]

As guests entered through the South Entrance House and descended a double staircase into the cool, air-conditioned space[37] within the Old Mill House, they would be greeted by color and movement. The eye would be drawn toward an animated image of a moving breast wheel projected onto the space where a real one had turned long ago. Nearby would be a working model that would demonstrate how water power had once driven pumps that propelled water from the Schuylkill River up to the Fairmount Reservoir.

Further on, the surviving components of the remaining test turbine would be preserved and highlighted, along with its pump and discharge main. Following the discharge main as it transitioned to an ascending main, guests would find themselves in a small theatre where a lively, 15-minute video played every half hour.

There would be a visitor-activated Make It Rain station featuring tiny plastic beads showering down upon a miniature landscape, an enormous mountain of trash called *Pollutionopolis* which would spotlight the problem of nonpoint-source pollution, a video exhibit featuring a simulated flight up the Schuylkill River controlled by the visitor by a joystick, and numerous other interactive exhibits designed to appeal to children. A science center would allow school groups and other guests to collect water from the Schuylkill River and project views of

[36] Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022.
[37] Particularly noticeable on hot summer afternoons.

the microscopic life found within it onto large, high-definition, digital wide-screen televisions.[38] A variety of interpretive panels would explain and illustrate the history of the Fairmount Water Works with graphics, historical images, and explanatory text.

Throughout the design of the Interpretive Center, a unifying graphical theme incorporating a visual wave pattern was designed to evoke the fluidity of water.

Above all, Feldman followed a mandate given him early on by Mark Thompson—do not let the exhibits overshadow or obscure the built environment of the Fairmount Water Works itself. The building is a star attraction in its own right; it's one of the things that visitors will come to see. Let it shine! So, for example, rough wall surfaces would remain exposed and illuminated by indirect lighting, the hulking discharge main would be made accessible and be incorporated into the design of the theatre, and the 1851 Jonval test turbine would be given pride of place.

Because the Interpretive Center was located in the Old Mill House and lower level of the Engine House, and therefore subject to periodic flooding, Feldman designed a clever way to adapt to the inevitable. He created something rare for a museum-type environment, possibly unique to Fairmount—a flood response plan. It consisted of three elements. First, he designed as many components as possible to be completely submersible for long periods of time without serious damage. Second, he designed a hoist system that would raise, above anticipated floodwaters, other components that could survive being moist but might more easily be damaged by debris. Third, he designed those components that could not survive being wet or moist—mostly the electronics—to be easily removable.

Feldman persuaded the Water Department to commit to having a schedule of workers on

[38] These were just beginning to become available at this time.

round-the-clock, short-notice standby to respond and implement the plan when monitors upriver indicated a flood event was imminent. In combination with a flood management plan adapted from an initial concept developed by Wick Fisher White and Mark B. Thompson Associates in 1996,[39] which coordinated utility shutoff and reactivation, the Interpretive Center was prepared to respond to flood events as best it could.

For the submersible components, Feldman selected materials that would not corrode or absorb water. Aluminum for framework and supports, for example. Delrin®, a high-density acetal plastic,[40] for sprockets and drive chains. Sintra®, an expanded (or "foamed"), low-density polyvinyl chloride (PVC) plastic,[41] for the interpretive panels and other surfaces. The text and images would be created using a high-pressure laminate (HPL) process that does not print on the surface but rather impregnates the plastic with color agents. The images and text produced in this way would not scuff or scratch off.[42] *Pollutionopolis* would be created using found trash, purchased items, and custom-sculpted components, and all covered with a coat of clear polyester resin commonly used in marine applications.[43]

Just about when the design was finished, funding reached a sufficient level—approximately $5.5 million[44]—that allowed physical work on the Interpretive Center to begin. The only hitch was that one of the grants stipulated an extremely tight deadline, approximately a year away. In fulfilment of the grant requirement, a target of 20 Sep 2003 was set for the

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[39] Mark B. Thompson Associates, *Flood Management Plan* (23 Oct 1996).
[40] Delrin®, is a DuPont product. See "Delrin®," *DuPont de Nemours, Inc.* (2022), <www.dupont.com/brands/delrin.html>, accessed 16 Jun 2022.
[41] Sintra®, is produced by 3A Composites, Inc. See "Sintra®," *3A Composites* (2022), <https://3acompositesusa.com/products/sintra/>, accessed 16 Jun 2022.
[42] Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022; Don LeCates, Fabricator, Universal Services Associates, telephone interview with author-editor, 17 Jun 2022.
[43] Jan Supco, Principal, 8 Stars Design, former Fabricator, Quinlan Scenic Studios, telephone interview with author-editor, 22 Jun 2022.
[44] "Clear Path [editorial]," *Philadelphia Inquirer* (3 Aug 2002), A6. The amount was the equivalent of approximately $9 million in 2022.

Interpretive Center's opening. The problem with this was that the City's procurement department insisted on performing all of the contracting themselves and there was no way they would be able to move that fast.

Eventually the Water Department contracted Steve Feldman as overall project manager and gave him sole source authority on not only final design but fabrication and installation as well. In other words, he had the ability to hire who he wanted to get the job done on time.

Feldman turned to Lynch Exhibits,[45] in Burlington, New Jersey, to produce and install the exhibits. Lynch accomplished most of the fabrication, but subcontracted the interactive pieces and animated models—like the Make It Rain exhibit and the working model of the breast wheel within the Old Mill House—to Universal Services Associates (USA) in Colwyn, a small suburb southwest of Philadelphia.[46] USA also fabricated the hoist system to Feldman's design.[47] Feldman hired Grenald Waldron Associates in Narberth, for the wiring and lighting. Jan Supco, of Quinlan Scenic Studios in Marcus Hook, crafted *Pollutionopolis* from a model Feldman had created.[48] Ann Clausen, Principal at Interpretive Solutions in Philadelphia, and provided research, historical images, and scripting for the interpretive panels while subcontracting in turn to Josh Feinberg for the science-related content.[49]

Craig Johnson's Talisman Interactive, located in Philadelphia, was hired by Feldman to produce the video shown in the theatre, including the filming, computer animation, and special

[45] Lynch Exhibits is no longer in business.
[46] Universal Services Associates has since relocated to Folcroft, a nearby municipality.
[47] Don Matz and Don LeCates crafted the breast wheel model, Don LeCates fabricated the Make It Rain exhibit, Art McDermott wired the exhibits for sound, and Paul LeCates contributed additional model work. Don LeCates, Fabricator, Universal Services Associates, telephone interview with author-editor, 17 Jun 2022.
[48] Jan Supco, Principal, 8 Stars Design, former Fabricator, Quinlan Scenic Studios, telephone interview with author-editor, 22 Jun 2022.
[49] Ann Clausen, former Principal, Interpretive Solutions, telephone interview with author-editor, 14 Jun 2022; Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022; Jan Supco, Principal, 8 Stars Design, former Fabricator, Quinlan Scenic Studios, telephone interview with author-editor, 22 Jun 2022.

effects, and all of the interactive audiovisual media like touch screens embedded throughout the exhibits. Johnson also created the interactive, joystick-controlled “flight” up the Schuylkill River from its mouth at the Delaware River in Philadelphia to its headwaters in Schuylkill County over 135 miles to the northwest. Johnson and Larry Freedman[50] recorded a soundtrack of disgusting noises for the *Pollutionopolis* exhibit.[51]

A late addition to Feldman’s contract called for a live closed-circuit video system that would record fish passing through the fish ladder on the western end of Fairmount Dam and transmit the view to the Interpretive Center. Feldman subbed out this work to Talisman Interactive as well.[52]

Under a separate contract, direct with the Water Department,[53] Johnson created the center’s website and designed and installed the system for displaying views of microscopic organism within collected river water onto large television screens in the science classroom.[54]

All of this would normally have taken a year and a half to accomplish, but by the time the contracting and subcontracting had been worked out there were only nine months left before opening day.[55] Some of those involved had to drop virtually everything else they were doing and concentrate on the Interpretive Center work. Craig Johnson and his team, for example, had to

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[50] Freedman is well-known among Philadelphia broadcasters for producing all of the highly recognizable jingles and other promotional audio for the local KYW NewsRadio station and KYW television news programs for the past thirty years.

[51] Some of the noises played continuously while others would activate when a proximity sensor was tripped or on some other visitor interaction such as the lifting of a toilet seat. Craig Johnson, Executive Director, Interpret Green Group, telephone interview with author-editor, 15 Nov 2021.

[52] Craig Johnson, Executive Director, Interpret Green Group, telephone interview with author-editor, 15 Nov 2021; Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022.

[53] Craig Johnson, Executive Director, Interpret Green Group, telephone interview with author-editor, 15 Nov 2021; Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022.

[54] Monica Peters, “Fun’s Flowing at Water Works,” *Philadelphia Inquirer* (21 Aug 2009), W31. This would become a favorite of the author-editor’s two children.

[55] Craig Johnson, Executive Director, Interpret Green Group, telephone interview with author-editor, 15 Nov 2021; Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022; Jan Supco, Principal, 8 Stars Design, former Fabricator, Quinlan Scenic Studios, telephone interview with author-editor, 22 Jun 2022.

hire a helicopter and acquire the permits necessary to allow flight at a relatively low altitude up the Schuylkill River, produce a live-action and animated video for the theatre in the new wide-screen high-definition format, design the electrical support systems, and help install the hardware and exhibits.

After nine months of frenetic activity, all of the exhibits had been created, installed, tested, and adjusted. The Interpretive Center was set for a soft opening on Friday 19 Sep 2003, with an official opening at eleven in the morning on the next day, Saturday 20 Sep. Glowing accounts in the local news in the week leading up to the opening encouraged people to go see it for themselves.[56] Everything was ready. What could go wrong?

If the reader has learned nothing else from this storied account of the Fairmount Water Works, it should be this: nothing about Fairmount has ever been straightforward. The grand opening of the Interpretive Center was no exception. As finishing touches were being completed, Hurricane Isabel was forming in the Atlantic Ocean. With landfall projected to take place in the Carolinas sometime on Thursday 18 Sep, advance safety preparations were made across the Mid-Atlantic regions of the United States. Isabel eventually tracked through eastern North Carolina, central Virginia, eastern West Virginia, western Maryland, and western Pennsylvania before breaking apart and being absorbed into other storm systems. High winds and heavy rains typical of eastern seaboard hurricanes caused flooding and property damage throughout the region.[57]

Early in the week, city officials postponed the opening of the Interpretive Center as a safety precaution.[58] The flood response plan was implemented. Where days earlier Fairmount

[56] “Opening the Visitor Tap: A Way to Soak Up History [editorial],” *Philadelphia Inquirer* (10 Sep 2003), A14; Ramona Smith, “Fairmount Water Works Reopening to Public,” *Philadelphia Daily News* (12 Sep 2003), 12, 14; Stephan Salisbury, “As Center Opens, Talk of Water Will Gush Out,” *Philadelphia Inquirer* (14 Sep 2003), B1, B4.
[57] “Summary of Hurricane Isabel,” *National Weather Service, National Oceanic and Atmospheric Administration* (2022), <www.weather.gov/ilm/2003-Sep-18hurricane>, accessed 28 May 2022.
[58] Edward Colimore, “As Isabel Close In, Checklists Are in Hand,” *Philadelphia Inquirer* (17 Dec 2003), B6.

bustled with the activity of installation, there was now deconstruction. What had been so carefully installed now had to be dismantled. Although there is a passenger elevator that travels between the main and lower levels of the Engine House, the lift car is small so nearly all of the removeable components were hauled up the stairs by hand. Once out, they were transported offsite for temporary storage. The hoist system was then used to raise the remaining non-submersible components. Although the flood response plan was implemented a great deal earlier than anyone would have wished, it worked flawlessly.[59]

Clean-up and reinstallation took weeks. The delayed grand opening took place on the morning of Wednesday 29 October. On the night prior to the public opening, a reception was held in the central room and on the deck of the Engine House. It rained all evening, but a tent had been erected over the deck. The tent turned out to be leaky but the guests would not be deterred; they cheerfully held umbrellas under the dripping water as they celebrated the long-awaited opening of the Fairmount Water Works Interpretive Center.[60]

Admission to the Interpretive Center was free of charge. The hours were 10:00 a.m. to 5;00 p.m. Tuesdays through Saturdays, 1:00 p.m. to 5:00 p.m. Sundays, and closed on Mondays. Parking for visitors was located along the former Aquarium Drive, now renamed Water Works Drive.[61]

Beyond the suite of perpetual exhibits,[62] additional programs and activities were

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[59] Edward F. Grusheski, former General Manager, Public Affairs, former Director, Fairmount Water Works Interpretive Center, Philadelphia Water Department, personal interview with author-editor, 15 Aug 2018; Craig Johnson, Executive Director, Interpret Green Group, telephone interview with author-editor, 15 Nov 2021; Steve Feldman, Principal, Steve Feldman Design, telephone interview with author-editor, 16 Jun 2022.
[60] Philadelphia Water Department, *Welcome pamphlet* (2003); Edward F. Grusheski, former General Manager, Public Affairs, former Director, Fairmount Water Works Interpretive Center, Philadelphia Water Department, telephone interview with author-editor, 15 Aug 2018.
[61] Ramona Smith, "Fairmount Water Works Reopening to Public," *Philadelphia Daily News* (12 Dec 2003), 12, 14; "Free: Fairmount Water Works Interpretive Center," *Philadelphia Inquirer* (12 Dec 2003), W39. Admission is still free today.
[62] "Water In Our World," *Philadelphia Inquirer* (2 Jan 2014), B2.

scheduled throughout the year. Special temporary exhibits were staged from time to time, focusing on such things as winter's effects on the river and its inhabitants,[63] the restoration of shad and other migratory aquatic animals,[64] a curated collection of trash found in the Wissahickon Valley,[65] and the way the Water Department turns river water into drinking water.[66] Some of these were part of regular "Science Saturdays."[67] Movies with an environmental theme were featured during "Cinema Sundays."[68] In addition to walk-in visitors, school groups were hosted throughout the week in a large room that functioned as a classroom activity area and instructional lab.[69] All of the exhibits, activities, and programs were designed to be both entertaining and educational. The Pennsylvania Department of Environmental Protection recognized the superb quality of the Interpretive Center's programming and designated it a Watershed Education Center for the Delaware River Basin and a Gateway Center for the Schuylkill River National and State Heritage Area.[70]

A year after the Interpretive Center opened, the Water Department assumed responsibility for the operation and maintenance of the Fairmount Fish Ladder. Migratory fish had been slow to take advantage of the facility after it was constructed in 1979 and had never used it in large numbers. By 1984 the Pennsylvania Fish & Boat Commission had stopped maintaining it or recording fish counts.[71] Staff from the Water Department's Office of Watersheds cleaned out the

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[63] "Investigating Winter Water," *Philadelphia Inquirer* (23 Dec 2005), W29; Monica Peters, "Varied Fun for a Winter's Day," *Philadelphia Inquirer* (23 Jan 2015), W28.
[64] Mari A. Schaefer, "A Rainy Earth Day Is No Washout for Fish," *Philadelphia Inquirer* (23 Apr 2006), B2.
[65] Stephan Salisbury, "Art Display Promotes Recycling," *Philadelphia Inquirer* (21 Apr 2015), B4; Jenelle Janci, "'One Man's Trash' Is, Well, Another Man's Trash," *Philadelphia Daily News* (22 Apr 2015), 25.
[66] "Washing Water at the Water Works," *Philadelphia Inquirer* (6 Mar 2015), W29.
[67] "Mind Menu: Science Saturdays," *Philadelphia Inquirer* (15 Jan 2012), D2; "Science Saturdays and Cinema Sundays," *Philadelphia Inquirer* (31 Oct 2014), W33.
[68] "Science Saturdays and Cinema Sundays," *Philadelphia Inquirer* (31 Oct 2014), W33.
[69] Monica Peters, "Fun's Flowing at Water Works," *Philadelphia Inquirer* (21 Aug 2009), W31.
[70] Philadelphia Water Department, *The Water Works: A Center of Transformation* (2015).
[71] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 2, 4, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania.

flooded viewing window[72] area and Johnson's Talisman Interactive installed the new video feed system.

Visitors to the Interpretive Center weren't the only ones who could watch fish passing through; scientists used the system to count fish as they passed.[73] Although the migratory numbers were still disappointing,[74] one creature did make a spectacular surprise appearance.

At two hours and 20 minutes past midnight on Monday 21 Mar 2005, a playful, three-foot, four-inch-long North American river otter was recorded swimming through the fish ladder. Its picture was published in the local newspapers[75] and children submitted name suggestions.[76] Of unknown sex, probably two years old, the presence of the otter showed that the health of Schuylkill River was improving. "The otter now has an ability to live in that water because it's clean enough now and there are lots of fish," observed Joe Perillo, a Water Department aquatic biologist who monitored the river and helped maintain the fish ladder. "It's a good indicator that the rivers are continuing to improve," concurred Water Department Public Affairs spokeswoman Joan Przybylowicz. "The fact that he's there means there are a lot of fish for him to feed on."[77]

Later that year, Gail Tomlinson left the Water Department and Public Education Manager Drew Brown provided temporary leadership as Director of the Interpretive Center for two years

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[72] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 15, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania.

[73] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 15, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania.

[74] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 2, Table 1 at 18, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania. This was despite the stocking of over a million shad fry into the river between 2000 and 2001. See Sandy Bauers, "Release of Fish Spawns Hope for Shad's Return to Schuylkill," *Philadelphia Inquirer* (5 Jun 2001), 71; Jane M. Von Bergen, "Monitoring the River's Health," *Philadelphia Inquirer* (2 Jun 2003), C1, C3.

[75] Ramona Smith, "Otter-ly at Home in the Schuylkill," *Philadelphia Daily News* (22 Apr 2005), 4; "He Otter Be in Pictures," *Philadelphia Inquirer* (23 Apr 2005), B2.

[76] It is unknown what name was eventually chosen.

[77] Ramona Smith, "Otter-ly at Home in the Schuylkill," *Philadelphia Daily News* (22 Apr 2005), 4.

until Grusheski selected Karen Young as long-term Director in 2007.

First hired as a Public Affairs intern in 1986, Young had worked with Grusheski and Brown since 1988, most notably creating educational programs for school children and encouraging middle school and high school teachers and administrators to send their students to the Fairmount Water Works on field trips. She developed placed-based education opportunities—including teacher's lessons and activities—that could be employed at Fairmount even before the Interpretive Center was completed. After it opened, Young served as an educator on the Interpretive Center staff, developing and leading creative programs designed to educate people about water resources and source water protection, rather new concepts at the time.[78]

Ed Grusheski retired from the Water Department in 2009 and Joanne Dahme returned to lead Public Affairs once again.[79]

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While the damage to the Engine House resulting from the fire on New Year's Day of 2002 was being repaired, progress on a restaurant was slowly moving forward. Recall that the Water Works Café had closed in the spring of 1982 because the operators were not equipped to repair the damage from a fire in the Engine House.[80] Afterward, a 1989 proposal from the owners of the upscale Chart House seafood restaurant chain was seriously entertained but fell

[78] C. Drew Brown, Public Education Manager, Philadelphia Water Department, telephone interviews with author-editor, 30 Jun 2021, 8 Jul 2021; Karen Young, Director, Fairmount Water Works Interpretive Center, Philadelphia Water Department, telephone interview with author-editor, 6 Jan 2022. Young continues as Director to the present.
[79] C. Drew Brown, Public Education Manager, Philadelphia Water Department, telephone interviews with author-editor, 30 Jun 2021, 8 Jul 2021; Joanne Dahme, former General Manager, Philadelphia Water Department, telephone interview with author-editor, 19 Jul 2021; Karen Young, Director, Fairmount Water Works Interpretive Center, Philadelphia Water Department, telephone interview with author-editor, 6 Jan 2022.
[80] The fire was not directly related to the operation of the café.

apart by 1992.

The Fairmount Park Commission in 1998 gave a company called Fairmount Park Management the exclusive responsibility managing all food concessions within the Fairmount Park system. When the company invited interested parties to submit bids for a restaurant operation, two responded—the owners of Catelli's Ristorante, a northern Italian restaurant in Voorhees, New Jersey, and the owners of Manayunk Brewery and Restaurant. Fairmount Park Management selected Catelli's in 2001.

Although Catelli's won the competition, a contract was not finalized, of course, while the specifics of the restaurant operation and any necessary renovations to the Engine House were worked out.[81] Although repairs to the fire damage were completed by the Fairmount Park Historic Preservation Trust in early 2003, negotiations with the company that owned Catelli's became bogged down over suspicions of favoritism, questions about the bidding process, and, most significantly, opposition to a proposed modification to the Engine House.

The biggest sticking point was the modification. After Catelli's was selected as the winning bid, Linda Catelli Rosanio, CEO of Star Group, a marketing company that owned Catelli's, proposed to add a large, moveable glass enclosure—a conservatory- or greenhouse-type structure—on the side of the Engine House facing the South Garden. With approximately 75 seats in the addition, the total capacity of the restaurant would be around 250.[82] Catelli's maintained that because they would need to invest $2 million[83] to complete the fit-out of the restaurant, the additional seating was necessary to make the operation financially viable.[84]

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[81] Stephan Salisbury, "Seeing Progress in Drips," *Philadelphia Inquirer* (9 Jul 2003), B3.
[82] Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.
[83] The equivalent of approximately $3.2 million in 2022.
[84] Stephan Salisbury, Interim Director Named for Fairmount Park, *Philadelphia Inquirer* (13 Feb 2003), B3; Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.

The proposed addition to the side of the Engine House elicited howls from the historic preservation community and protests from the general public. Even though the greenhouse structure was designed to be portable, it would likely stay put. Any addition to the Engine House would mar its appearance from the South Garden, argued John A. Gallery, Executive Director of the Preservation Alliance of Greater Philadelphia.[85] Gallery later added:

> The proposed addition would terribly detract from one of Philadelphia's most revered historic sites. … It's location and design are completely in conflict with the [federal] secretary of the interior's standard for additions to National Historic Landmarks, which this building is. Moreover, neither the proposed restaurant developer nor the commission has ever been able to demonstrate that this addition is necessary to operate a restaurant in the Engine House.[86]

Both the Philadelphia Historical Commission and the Art Commission, both of whose approvals were necessary, balked at giving their okay.[87] The Historical Commission attempted to find other solutions, but the owners of Catelli's were intransigent.[88]

The questions about the bid process were closely related to the insistence on adding the glass enclosure. The structure and the additional seating within it were not a part of the original bid. If Catelli's had the opportunity to make a significant change to their proposal after their bid was selected, Michael Rose and Harry Renner IV, the two who had submitted the losing bid, protested that they should be allowed to do the same.[89]

They had a point. If Catelli's could not make a go of the restaurant with their original bid,

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Recall that the Chart House proposal had foundered on a similar, if more extreme, demand. That concept involved expanding onto the deck of the Old Mill House, cutting a stairway into the deck below the Pavilion, and enclosing the Pavilion in glass.

85 Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.

86 Gallery to editor, *Philadelphia Daily News* (18 Nov 2003), 11.

87 "Plans for Fancy Restaurant at Waterworks in Danger, *Philadelphia Daily News* (22 Mar 2003), 63.

88 Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.

89 Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.

why was their bid selected? What kind of analysis was conducted in selecting them? Why couldn’t Rose and Renner modify their bid and re-submit it? Even John F. Street, the mayor at the time, weighed in on the issue, saying that his procurement office was examining whether or not Catelli’s insistence on doing something significantly outside of the bounds of their bid was cause for re-bidding the whole thing.[90]

Added to the mix was the whiff of impropriety. One of the Fairmount Park Commissioners, John K. Binswanger, was also co-chairman of a real estate firm that had provided a business loan to a company called Culinary Concepts. Owned by James and Janet Israel, Binswanger’s son-in-law and daughter, Culinary Concepts was a supplier and partner company of Fairmount Park Management, the company contracted by the Fairmount Park Commission to manage all of the food concessions within the park system. Fairmount Park Management was co-owned by James Israel[91] and had selected Catelli’s to run the restaurant in the Engine House.

Rose and Renner, whose bid had lost to Catelli’s, charged that the family relationship was the reason the Fairmount Park Commission was so wedded to Catelli’s. To be fair, Binswanger had not been a commissioner when all of the deals were made, and since becoming a commissioner had recused himself from all votes concerning Fairmount Park Management, Catelli’s, or the Fairmount restaurant issue. To many observers, however, it all just felt too cozy by half.[92]

David B. Brownlee, Chairman at the time of the University of Pennsylvania’s Art History

[90] Stephan Salisbury, “New Troubles Stem Water Works Progress,” *Philadelphia Inquirer* (19 Aug 2003), B1, B8.
[91] Stephan Salisbury, “New Troubles Stem Water Works Progress,” *Philadelphia Inquirer* (19 Aug 2003), B1, B8. Judith Nilon was the other co-owner.
[92] Stephan Salisbury, “New Troubles Stem Water Works Progress,” *Philadelphia Inquirer* (19 Aug 2003), B1, B8.

Department and former member of the Philadelphia Historical Commission,[93] commented:

> This is one of the most famous pieces of public landscape and when we undertake to change it, the standards should be very high. We're looking for a selection process that guarantees a building of exceptional quality, and above all we're looking for a process that is above reproach. Great works of a great city should be done in a way that inspires confidence. It's hard to say the process here inspires confidence.[94]

The editorial board of the *Philadelphia Inquirer* came out strongly against Catelli's. While granting that Catelli's may indeed have had a hard time earning a profit without the glass addition, and noting that accusations of conflict of interest weren't exactly substantiated, it argued that the selection process had been botched and concluded, "Time to dump this sorry stew and start again."[95]

The Fairmount Park Commission decided to scrap the entire process and do what the *Inquirer* recommended—start over. Robert N. C. (Bobby) Nix III, Commission President, announced that they were once again seeking new proposals.[96] A modified selection process would include a review panel with a representative from the mayor's office and former Commissioner and Fairmount champion Ernesta Ballard, and would incorporate a series of public meetings.[97]

This time around, significantly, no proposals would be accepted that were not "compatible with the long-term preservation of the Engine House and consistent with its status as

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[93] It may be recalled that Brownlee is the author of *Building the City Beautiful: The Benjamin Franklin Parkway and the Philadelphia Museum of Art* (Philadelphia: Philadelphia Museum of Art, 1989), one of the sources for information included in chapter 10 of this work.
[94] Stephan Salisbury, "New Troubles Stem Water Works Progress," *Philadelphia Inquirer* (19 Aug 2003), B1, B8.
[95] "Garcon, A New Eatery Plan [editorial]," *Philadelphia Inquirer* (10 Sep 2003), A14.
[96] Stephan Salisbury, "Water Works Proposals Sought," *Philadelphia Inquirer* (11 Sep 2003), B1, B14; "City Seeks New Ideas for Using Water Works' Engine House," *Philadelphia Inquirer* (8 Nov 2003), B2.
[97] "Garcon, A New Eatery Plan [editorial]," *Philadelphia Inquirer* (10 Sep 2003), A14.

a National Historic and Engineering Landmark."[98] The Fairmount Park Commission declared that any restaurant concept must fit within the footprint of the existing building. This ruled out any greenhouse addition. Although the owners of Catelli's were welcome to participate, they remained adamant that they could not make a restaurant work financially without expanding the Engine House. By March of 2004 they had removed themselves from further consideration.[99]

While the Fairmount Park Commission began to fire up the process from a cold start once more, the editors of the *Inquirer* expressed optimism that if the Commission moved quickly enough, the city could see a restaurant at Fairmount by the end of the summer.[100] Commission President Nix expressed his expectation that a contract could be awarded by late summer with some sort of food service active by the fall.[101] That fast? Hope sprang eternal, apparently.

After receiving encouraging responses from several parties to an informal request for expressions of interest,[102] the Fairmount Park Commission issued a formal request for proposals. After the bids were opened in August 2004,[103] two submissions were selected for further consideration, one from MAK Consulting and one from Engine House Partners.[104] MAK was led by 33-year-old Michael A. Karloutsos,[105] a local businessman and political fundraiser, and included the owner-operators of two Manhattan restaurants. Engine House Partners included Tim Bonnie, the owner of Solaris Grille in Chestnut Hill, Johnny Mañana's in East Falls, and other

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[98] "City Seeks New Ideas for Using Water Works' Engine House," *Philadelphia Inquirer* (8 Nov 2003), B2.
[99] Stephan Salisbury, "Commission Will Try Again for a Water Works Restaurant," *Philadelphia Inquirer* (11 Mar 2004), B6.
[100] To Dream, To Eat, To Relax Along the River [editorial]," *Philadelphia Inquirer* (27 Mar 2004), A7.
[101] Sono Motoyama, "Water Woirks On Fast Track?" *Philadelphia Daily News* (15 Jun 2004), 94.
[102] "Water Works Attracts New Interest," *Philadelphia Daily News* (9 Jun 2004), 30.
[103] "Philadelphia Procurement Dept. Postponement Notice," *Philadelphia Daily News* (27 Jul 2004), 44. Although the Fairmount Park Commission made the selection decisions, it is worth pointing out that the Mayor's office of procurement managed the overall bid process this time around.
[104] Michael Hinkelman, "Calder Garden Just Start of Parkway Makeover," *Philadelphia Daily News* (5 Nov 2004), 12.
[105] Pronounced "kar-LOOT-sauce."

neighborhood restaurants, and the owner of Sonoma, a popular spot in the Manayunk neighborhood.[106]

MAK's concept was a Mediterranean-themed restaurant. Although upscale, it was designed to appeal both to a well-dressed clientele in the evening and to the strollers, roller bladers, and cyclists from the Schuylkill River Trail at its front door during the day, rather like Tavern On the Green in New York's Central Park, according to Karloutsos. Engine House Partners' proposal, on the other hand, was more middle-brow, with general American faire. "I don't want it to be too high-end or low-end," said Bonnie. "I want something that everybody can enjoy."[107]

After presentations by both parties on 10 November,[108] the Fairmount Park Commission announced at its next monthly meeting, on 8 December 2004,[109] that it had selected MAK Consulting as the winning bidder.[110] Provisionally called Thea at the Water Works,[111] plans were for a 120-seat indoor restaurant that could also accommodate the same number outdoors on the deck during warmer weather. Karloutsos said he expected to generate $3 million in annual revenue,[112] twice the amount Engine House Partners had projected with their concept.

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106 Michael Hinkelman, "Calder Garden Just Start of Parkway Makeover," *Philadelphia Daily News* (5 Nov 2004), 12; Michael Hinkelman, "Park Panel Weighs Restaurant Plans," *Philadelphia Daily News* (11 Nov 2004), 26.
107 Michael HInkelman, "Park Panel Weighs Restaurant Plans," *Philadelphia Daily News* (11 Nov 2004), 26.
108 Michael Hinkelman, "Park Panel Weighs Restaurant Plans," *Philadelphia Daily News* (11 Nov 2004), 26.
109 The day before the restaurant announcement was made, Fairmount Park Commission President Bobby Nix called Karloutsos and notified him that his Manhattan partners had backed out of the arrangement, taking their millions in financial backing with them. Though now lacking funding, Karloutsos asked for time to pull things together and the announcement was made the following day anyway. While walking to the Capital Grill, his usual haunt for lunch, Karloutsos bumped into the restaurant's manager, Ed Doherty, on Broad Street. Doherty related that he was leaving the Capital Grill; Karloutsos invited Doherty in and over coffee recruited him to manage the Water Works. While leaving, Karloutsos encountered the chairman of the Philadelphia Industrial Development Corporation (PIDC). The chairman mentioned that he was thrilled to see the Fairmount Water Works finally getting the restaurant it needed and offered to support it if any assistance was eventually needed. Karloutsos told the chairman that he was still looking to replace the funding dropped by the initial investors and started a conversation that eventually resulted in a $2.1 million business loan from the PIDC. Karloutsos, Michael A., former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.
110 Jennifer Lin, "Water Works Eatery Plan Wins Support," *Philadelphia Inquirer* (9 Dec 2004), B4.
111 In Greek, *thea* (θεά) means alternatively "view" or "goddess."
112 The equivalent of approximately $4.7 million in 2022.

It wasn't until nine months later, in September of 2005, that the contract negotiations were finalized and a lease signed. MAK Consulting would pay the restaurant's utility bills to the Fairmount Park Commission, as well as $120,000 per year for security and maintenance.[113] It would also pay three percent of gross receipts to the City's general fund. The City agreed to devote 80 parking spaces along Fairmount Avenue, between the *Fountain of the Sea Horses* and Kelly Drive, for the exclusive use of restaurant patrons each day between eleven in the morning and eleven in the evening.[114]

Karloutsos invested approximately $3.2 million dollars[115] for the final fitting out of the restaurant, including the refurbishment and appointing of the entryway, waiting area, and central room of the Engine House, the construction of a bar area in the Caretaker's House, installation of kitchen equipment that included a one-ton stove hood, and the glassing in of the central portion of the riverside porch.[116] Karloutsos hired Ed Doherty to manage the restaurant and Adan Trinidad to serve as executive chef. The acclaimed Doherty had been managing the Capital Grill in Center City[117] and Trinidad was a promising 24-year-old up-and-comer from Mexico.[118]

True to Fairmount form, the opening of the restaurant was delayed. Karloutsos had been planning on a late June opening, but high water had forced a postponement.[119] At least one critic

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[113] The equivalent of approximately $182,000 in 2022.

[114] Stephan Salisbury, "Commission Backs Plan for Skate Park," *Philadelphia Inquirer* (15 Sep 2005), B7.

[115] Marcia Gelbart, "Another Cloud Over the Water Works," *Philadelphia Inquirer* (18 Jul 2011), A1. The amount was the equivalent of approximately $4.8 million in 2022.Karloutsos obtained the funds from a combination of the $2.1 million PIDC loan and other sources. In addition to the restaurant, Karloutos and his wife Anastasia put up their home for collateral. Karloutsos' parents, parents-in-law, and two sisters-in-law did the same. Karloutsos and his wife owned approximately 62 percent of the business, with the remainder divided between the relatives. See also Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.

[116] Stephan Salisbury, "Time for Water Works," *Philadelphia Inquirer* (9 Jul 2006), B1, B7. Most of the deck remained open.

[117] Michael Klein, "Restaurant Shakeup," *Philadelphia Inquirer* (2 Feb 2006), E9; Stephan Salisbury, "Time for Water Works," *Philadelphia Inquirer* (9 Jul 2006), B1, B7.

[118] Lari Robling, "Dining on the Schuylkill," *Philadelphia Daily News* (28 Sep 2006), 32; Michael Klein, "Wing Bowl Could Lose a Big Eater," *Philadelphia Inquirer* (5 Dec 2006), D2.

[119] Stephan Salisbury, "Time for Water Works," *Philadelphia Inquirer* (9 Jul 2006), B1, B7.

brushed off the delay. “In my thirteen years of writing Table Talk,” said *Philadelphia Inquirer* food scene observer Michael Klein, “I have never seen a restaurant open on time, aside from these cookie-cutter chain restaurants on the outskirts of malls.”[120] Now called the Water Works Restaurant and Lounge, the venue opened during the week of Monday 17 Jul 2006.[121] The same editorial board of the *Inquirer* declared it “worth the (long) wait.”[122]

Open for lunch and dinner, the restaurant combined with the Interpretive Center to attract a variety of visitors to the Fairmount Water Works once again. In addition to the intentional visitor, strollers, joggers, cyclists, and roller bladers from the Schuylkill River Trail that passed through the grounds began to stop on impulse—to grab a bite, to explore the water- and history-themed exhibits, or to simply pause and take in the views of the river from the Mill House decks, enjoy the sight of the Fairmount Dam from the Pier, or admire anew the architecture of the buildings.[123]

The restaurant’s menu featured grilled lollipop lamb chops with lemon-mint yogurt, pan-seared crab cakes over remoulade, oysters prepared three ways, tuna prepared three ways, grilled octopus, house-cured citrus salmon, lobster bisque with crème fraîche and chive oil, and caramelized three onion soup with Gruyère churro for appetizers. Entrees included rack of lamb over goat cheese pillows with watercress artichoke salad and honey-mint sauce, whiskey-glazed Kurobuta porch chop with oven-baked apples, pan-seared duck breast over yam risotto with baby maché salad and cherry balsamic glacé, chicken stuffed with truffle Boursin with creamy lobster

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[120] Michael Klein, “Spanish Tapas Bar Ferdinand is N. Liberties’ Latest,” *Philadelphia Inquirer* (13 Jul 2006), F2.
[121] Michael Perez, “Boathouse Row is Seen Through Wine Glasses,” *Philadelphia Inquirer* (20 Jul 2006), B1; Rick Nichols, “A Fine Night for Finally Dining at the Water Works,” *Philadelphia Inquirer* (27 Jul 2006), F1, F2. Two months earlier, Karloutsos had begun managing a café in nearby Lloyd Hall on Boathouse Row. Lloyd Hall had been completed in 1998 but the café was new. See “Boathouse Row Café Opens in Lloyd Hall,” *Philadelphia Daily News* (23 May 2006), 16.
[122] “Worth the (Long) Wait [editorial],” *Philadelphia Inquirer* (15 Jul 2006), A12.
[123] Lari Robling, “Dining on the Schuylkill,” *Philadelphia Daily News* (28 Sep 2006), 32.

and asparagus couscous, pan-seared Tasmanian salmon over cannellini ragout with lotus root salad and arugula coulis, Chilean sea bass with butternut squash ravioli over caramelized pearl onion with beurre noisette, and a variety of angus steaks. The dessert menu offered the like of iced white peach soup, warm strawberry financier, and warm chocolate truffle cake with Manouri ice cream.[124]

In keeping with the water theme at Fairmount, an innovative water bar was created in the Caretaker's House. At one point it featured over 40 brands of various types of bottled water—from sources such as artesian springs, mineral springs, and glaciers—from far-flung places like Norway, Italy, New Zealand, South Africa, and Fiji. In imitation of fine wine, regular tastings were held.[125]

Reviews were uneven. Noting the menu's rather high price points, *Daily News* restaurant critic Lari Robling thought the entrees needed improvement. She called the cocktails, however, "solid," the appetizers good, the desserts "a home run," and the bar "pleasant." She judged the array of wines by the glass—served in proper wine glasses to magnify the bouquet, Robling observed—to be impressive, well-priced, and customer-friendly. Chef Trinidad received praise for interpreting Mediterranean dishes with his native Mexican culinary sensibility.

For Robling, the key question was, "Can this fledgling restaurant make the experience worth a bill that could make Poseidon drown in debt?" She answered herself, "Taking into consideration Waterworks is out of the gate a few short months, it has a promising start. With a

[124] *Dinner Menu,* Water Works Restaurant and Lounge (2006); Lari Robling, "Dining on the Schuylkill," *Philadelphia Daily News* (28 Sep 2006), 32; Craig LeBan, "The Water Works," *Philadelphia Inquirer* (29 Oct 2006), M5.

[125] Dianna Marder, "Water's New Splash," *Philadelphia Inquirer* (4 Jan 2007), F1f; Jill Porter, "Nectar of the Gods," *Philadelphia Daily News* (20 Jul 2007), 3f, 22; Ray Hathaway to editor, *Philadelphia Inquirer* (15 Jan 2007), A10. The tastings invited derision, but it turns out that many waters, especially those from mineral springs, can be distinguished without difficulty. See Dianna Marder, "How to Select Waters," *Philadelphia Inquirer* (4 Jan 2007), F2.

little attention to detail in the kitchen and some time for the waitstaff to get some confidence, this could become a contender for Philly's top dining." Robling rated the restaurant two forks out of four.[126]

The restaurant critic for the *Inquirer* was less satisfied. Craig LaBan called it interesting but hit-or-miss and gave it one bell out of four. "At $24 to $32 an entrée," he commented, "it's hard to sympathize."[127] He commended the tasteful updating of "the building's neoclassical spirit" and described the venue for his readers:

> Karloutsos…did a surprisingly nice job designing the restaurant himself, dressing it in unfettered elegance that lets the space speak for itself. The vaulted ivory main dining room, the former engine house, has been gilded with a water wall and crystal chandeliers that illuminate like a Christmas tree when the setting sun is at its reddest peak. A glassed-in front porch and a side breezeway with romantic semicircular booths on the way to the cozy bar each have a river view that is magical when the moonlight glows.[128]

LaBan's evening was apparently soured by the nuisance of a lengthy visit by a hovering police helicopter and an apathetic response by assistant manager Leonidos Agonastos[129]—while both Doherty and Karloutsos were away—to the surprise appearance of a riverside rodent.[130]

In December 2006,[131] less than five months after the restaurant opened, Karloutsos fired executive chef Adan Trinidad. Perceived by many as a response to LeBan's so-so review, it was in fact because the chef was verbally and psychologically abusive to the staff.[132] Pastry chef

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[126] Lari Robling, "Dining on the Schuylkill," *Philadelphia Daily News* (28 Sep 2006), 32.
[127] The equivalent of $35.26–47.01 in 2022.
[128] Craig LeBan, "The Water Works," *Philadelphia Inquirer* (29 Oct 2006), M5.
[129] Agonastos was Karloutsos' was married to Karloutsos' sister Sophia. See Marcia Gelbart, "Another Cloud Over the Water Works," *Philadelphia Inquirer* (18 Jul 2011), A1, A4.
[130] Craig LeBan, "The Water Works," *Philadelphia Inquirer* (29 Oct 2006), M5.
[131] Michael Klein, "Wing Bowl Could Lose a Big Eater," *Philadelphia Inquirer* (5 Dec 2006), D2.
[132] "I know that happens a lot in the restaurant industry," Karloutsos later explained, "but that wasn't going to happen in my restaurant. … When I learned about it, I warned him, sat him down, played it strictly by the book. …

Chad Durkin filled in as executive chef until Karloutsos hired Darryl Harmon the following April. With Harmon's arrival, Augustine Cubero was brought in from Le Bec-Fin,[133] the celebrated French restaurant in Center City Philadelphia, to manage the dining room.[134] Harmon implemented some changes to the menu, but more importantly brought much-needed precision to the execution of the menu and operational confidence borne of experience.[135]

A year after the restaurant opened, *Inquirer* food critic Rick Nichols provided an updated review. He observed:

> Things went about as rockily as they could in reviving the space so it is no surprise that the first year hasn't been a cakewalk: The heating and air-conditioning were erratic divas. The opening chef wasn't ready for prime time. Wildlife weary of life on the river occasionally popped up uninvited.[136]

Nichols praised the food and service, citing numerous improvements like a kitchen "righted" by Harmon and white linen tablecloths for the tables on the deck. He reported that Andre Darwish, a former maître d' of Le Bec-Fin, was so impressed that he temporarily came out of retirement to serve in the same position at the Water Works.[137]

The same summer the restaurant was lauded for its outdoor dining. One writer called it "a shoo-in favorite with many locals…with one-of-a-kind veranda vistas of Boathouse Row and the

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When I figured out that he wasn't listening, he had to go." Because of the timing, five weeks after LeBan's article, Karloutsos was concerned that it would appear the article was the reason for the firing. Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.

[133] French for "fine palate."

[134] Michael Klein, "Owner of Landmark Spence Café Branches Out," *Philadelphia Inquirer* (19 Apr 2007), F2; Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.

[135] Two years later, Harmon would be named "Chef of the Year" by the Culinary Federation. See "2012 Taste Philadelphia Festival Culinary Demonstrations," *Philadelphia Daily News* (4 Oct 2012), 72; "Gloucester City's O'Donnell's Pub & Grill Gains New Name, Chefs and Menu," *NJ.com* (8 Mar 2017), <www.nj.com/south-jersey-towns/2017/03/gloucester_citys_odonnells_pub.html>, accessed 21 Jun 2022.

[136] Rick Nichols, "A Year Later, It's the Place to Be," *Philadelphia Inquirer* (24 Jun 2007), M3.

[137] Rick Nichols, "A Year Later, It's the Place to Be," *Philadelphia Inquirer* (24 Jun 2007), M3.

Schuylkill." With seating outside for 98, it was one of the largest alfresco venues in the region.[138]

Even the take-out service received kudos. Menu selections described by a journalist as "sensual a la carte choices," such as French baguette sandwiches, pasta salads, Napoleon pastries, and crème brûlée, were boxed specifically to be enjoyed as a picnic on the grounds of Fairmount, from the South Garden to the Mercury Pavilion.[139]

During its first year, the restaurant was identified by *Inquirer* writer Karen Heller as one of the most romantic in Philadelphia. Patrons agreed. There were 31 marriage proposals in the first 5 months alone, with 101 during the first year and a half. Table 42, the middle of three semicircular, two-place banquettes along the back wall of the passageway between the Engine House and the Caretaker's House, was the favorite for "popping the question," witnessing roughly two thirds of the proposals. And no wonder—it was snug and rather private, but still offered a grand view of the river through floor-to-ceiling plate glass windows.[140]

The restaurant became a place to see and be seen, attracting national celebrities as well as well-known locals.[141] It was used for location shooting of scenes for movies[142] and television programs[143] and hosted fund-raising events for political campaigns.[144] It was eventually named

[138] April Lisante, "Alfresco, Old & New," *Philadelphia Daily News* (12 Apr 2007), 37ff; Marilynn Marter, "Area's Alfresco Menu Still Growing," *Philadelphia Inquirer* (21 Jun 2007), F1.
[139] April Lisante, "Takeout Goes Upscale," *Philadelphia Daily News* (7 Jun 2007), 41.
[140] Karen Heller, "Tables for Two," *Philadelphia Inquirer* (8 Feb 2007), F1, F4; Michael Klein, "On Second Thought, She Won't," *Philadelphia Inquirer* (18 Dec 2007), E2; Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022. Regrettably, there is no record of the percentage of the proposals that elicited a positive response.
[141] For example, Dan Gross, "Rocky Round-Up," *Philadelphia Daily News* (11 Sep 2006), 39.
[142] For example, "The Best and the Brightest," *Philadelphia Daily News* (6 Jul 2009), 28. Film producer M. Night Shamalan also hosted a Philadelphia film office soirée. See Rick Nichols, "A Year Later, It's the Place to Be," *Philadelphia Inquirer* (24 Jun 2007), M3.
[143] For example Dan Gross, "Interior Gal Gets Exterior Assist," *Philadelphia Daily News* (14 Aug 2007), 33; "Holidate," *Philadelphia Daily News* (30 Jul 2009), 29.
[144] For example Marcia Gelbart, "Another Cloud Over the Water Works," *Philadelphia Inquirer* (18 Jul 2011), A1. Pennsylvania Senator Bob Casey held political fundraisers at the restaurant. Presidential candidates Barack Obama and Rudoph Giuliani held a primary election party there in 2008. See also Rick Nichols, "A Year Later, It's the Place to Be," *Philadelphia Inquirer* (24 Jun 2007), M3.

one of the top 100 experiences in the world by *Saveur* magazine.[145]

In 2010, the organization that administers the Fairmount Park System, which includes the buildings, grounds, and concession of the Fairmount Water Works, changed considerably.

Created by the Pennsylvania state legislature, the Fairmount Park Commission had managed the park system from 1867 to 2010. The Commission itself consisted of 16 members. Six were municipal officials who served *ex officio* by virtue of the municipal positions they occupied. Ten other ten were private citizens appointed by the Court of Common Pleas. The private citizens were appointed to five-year terms and often served for multiple terms. One of the citizen-commissioners served as president of the panel. A professional park staff, headed by an executive director, supported the Commission and managed the day-to-day operation of the myriad parks and historic buildings.

A semi-autonomous body, the Commission had the authority to create and enforce regulations, hire staff, and license concessions within the parks. Until 1972, it operated its own police force, the Fairmount Park Guard. Unlike arrangements in many other American cities, however, the Commission could not raise its own revenue but had to request annual appropriations from the mayor and city council.

Despite the board's meetings being regularly publicized and its budget annually published, the Commission's operations and finances had long been perceived—fairly or unfairly—as opaque and its decisions as lacking in accountability. After a 2007 scandal in which it supported leasing park land in northeast Philadelphia to a local commercial venue and a medical facility in clear contravention of the posthumous wishes of the land's donor, a public

[145] "2012 Taste Philadelphia Festival Culinary Demonstrations," *Philadelphia Daily News* (4 Oct 2012), 72.

referendum to dissolve the Commission was approved by voters the following year.[146]

The Fairmount Park Commission was dissolved in 2010 and its professional staff was merged with the Philadelphia Department of Recreation, which was renamed Philadelphia Parks & Recreation. The title of the head of the agency was changed from Commissioner of Recreation to Commissioner of Parks & Recreation; this person continued to report directly to the mayor. Philadelphia Parks & Recreation is the City agency that now owns and manages the property and buildings of the Fairmount Water Works.[147]

Around the same time, despite the laurels the restaurant was earning from experts and the public alike, a series of controversies revealed that running it was more of a struggle than it appeared from the outside. Two incidents in particular were such that either one alone could have resulted in a fatal blow to a less resilient operation.

In April 2010, Leonidas Agorastos, Karloutsos' brother-in-law, partner, and assistant manager,[148] pleaded guilty in federal court to embezzling more than a million dollars from the restaurant. Because he owned a vending company that handled the invoices from food and service providers, he was able to inflate the bills, charge the restaurant the higher amounts, and pocket the difference. He had been doing that since before the restaurant had opened its doors. He was sentenced to 33 months in prison at Moshannon Valley Correctional Institution in

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[146] *Laws, Ordinance and Regulations Relating to Fairmount Park and Other Parks Under the Control of the Fairmount Park Commission* (Philadelphia: 1933); Catherine Lucey, "Mayor Nutter Appoints Parks and Rec Commission," *Philadelphia Inquirer* (2 Jul 2009); James McClelland and Lynn Miller, *City in a Park: A History of Philadelphia's Fairmount Park System* (Philadelphia: Temple University Press, 2015).

[147] *Laws, Ordinance and Regulations Relating to Fairmount Park and Other Parks Under the Control of the Fairmount Park Commission* (Philadelphia: 1933); Catherine Lucey, "Mayor Nutter Appoints Parks and Rec Commission," *Philadelphia Inquirer* (2 Jul 2009); James McClelland and Lynn Miller, *City in a Park: A History of Philadelphia's Fairmount Park System* (Philadelphia: Temple University Press, 2015).

[148] Agorastos was a partner by virtue of his and Sophia's having put up their home as partial collateral for the restaurant's business loan.

Phillipsburg, Pennsylvania, and ordered to pay restitution of over $400,000 to the restaurant.[149] Karloutsos later recalled:

> He was a predator, a sociopath. He took advantage of my sister, my wife's sister, and ultimately the entire family. He embezzled over a million dollars and went to prison for it. … He got what was coming to him. It was easily one of the worst experiences of my life. You trust someone, welcome them into your home and family, decide to love them, and give them opportunity. … We were duped.[150]

Fifteen months later, Vincent D'Ambrosio, a putative one-time business partner, sued Karloutsos and 12 of his relatives with an ownership stake, asserting that he and Karloutsos had initially agreed to a 50-50 partnership and then negotiated a 90-10 split when D'Ambrosio was unable to contribute to the securing of the business loan. In an attempt to bolster his case, he made dramatic claims about Karloutsos and his family members skimming profits and demanded the court appoint a special receiver for the business. The court denied the man's claims, but the reporting of the episode didn't help the reputation of either Karloutsos or the restaurant.[151]

In the spring of 2012, yet another issue popped up. It came to light that until 2010, and then again since 2011, the City of Philadelphia had been paying the restaurant's utility bills instead of Karloutsos. Although it was reported that the electricity bill alone amounted to approximately $225,000,[152] there was no way of obtaining an accurate total.[153]

When asked by a reporter, Philadelphia Parks & Recreation Property and Concessions Management Director Robert Allen and First Deputy Commissioner Mark Focht both essentially

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[149] Marcia Gelbart, "Another Cloud Over the Water Works," *Philadelphia Inquirer* (18 Jul 2011), A1, A4; Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022. The amount was the equivalent of approximately $527,000 in 2022.
[150] Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.
[151] Marcia Gelbart, "Another Cloud Over the Water Works," *Philadelphia Inquirer* (18 Jul 2011), A1, A4.
[152] The equivalent of approximately $296,000 in 2022.
[153] Holly Otterbein, "Bill of Fair?" *Philadelphia Daily News* (3 May 2012), 3f;

responded, That can't be right; we don't do that for anyone. After looking into it, however, Allen stated, "The problem is not that the restaurant is not paying; we dropped the ball administratively and failed to issue the bills." The *Daily News* editorial board placed the blame squarely with the City of Philadelphia.[154]

The real problem was that since the restoration, none of the utility systems for the restaurant had been separated from the other users at Fairmount. A single electrical meter, for example, covered the restaurant, the Interpretive Center, a small concession Karloutsos once managed in Lloyd Hall just up the street, the same concession in Lloyd Hall now under a different operator,[155] and the exterior lighting leading to Boathouse Row. As Karloutsos later described it:

> Not only were we not receiving invoices, but after it was reported in the news, Parks & Rec started sending me copy-and-paste bills in exact round numbers from month to month, for crazy amounts of electricity. They were not based at all on actual consumption. It was impossible that the bills were genuine. I asked them to prove it and they couldn't.
>
> I would say to them, "That can't be right. Our size is such-and-such; how do you come up with this measurement? Are you including the Interpretive Center or the external walkways and lighting that we don't control?" After months of back-and-forth, I finally got them to come on site and we went up to the second floor of the Engine House where the utilities are controlled. My people and the Parks & Rec people were together and it was dark out. I said to them, "If I flip this switch off, you're saying that only the restaurant lights will go out?" "Yes, yes, absolutely," they replied. "That's how we wired it; look at the drawings." When I flipped the switch, however, not only did the restaurant lights go out, but all of the outdoor lights at the Fairmount Water Works and all of the street lighting along Waterworks

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[154] "Whither Watchdogs? [editorial]," *Philadelphia Daily News* (4 May 2012), 19.
[155] Holly Otterbein, "Other Riverside Eateries Had City-Paid Utilities," *Philadelphia Daily News* (19 Jun 2012), 17f.

> Drive up to Boathouse Row went out as well.[156]
>
> But I had already appeared in the newspapers to be “stealing from the taxpayer”[157] instead of paying my bills. I kept telling everybody that all I wanted was a real bill so I could pay it. I’m not going to pay a penny more than I should. It’s not my job to pay for what someone else is doing. But because I was a private enterprise, I suppose, I was the bad guy because I was trying to make money. Never mind that I was supporting 110 people at the peak of the restaurant operation.[158]

By Karloutsos’ account, running the restaurant became a constant struggle and it eventually wore on him and his wife Anastasia. One day when they were on vacation, Karloutsos took their four children out to have fun and Anastasia stayed in their hotel room to work the payroll. Upon their return, Karloutsos found his wife in tears. “I feel like we’re slaves,” she cried. “I just want my life back.”[159] Karloutsos recounted:

> We were constantly fighting the city. They fought us on the utilities, they fought us on the percentage they were going to receive, and we had to fight to hold them accountable for maintenance. By our agreement, we were paying $120,000 per year for maintenance and security, but the money wasn’t set aside. It was being used as a slush fund; they were taking from Peter to pay Paul.
>
> By that point we had four kids and my wife and I were just tired, tired of fighting. I felt like I had succeeded but couldn’t fight anymore. It just wasn’t worth it any longer. My wife didn’t want to do it anymore. “Let’s sell,” she said. “Let’s get out.” That’s how we ended up

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[156] This area is part of Fairmount Park. It and Lloyd Hall, the municipal recreation center at 1 Boathouse Row where Karloutsos was managing a café at the time, were administered by Philadelphia Parks & Recreation. See “Boathouse Row Café Opens in Lloyd Hall,” *Philadelphia Daily News* (23 May 2006), 16.
[157] Jim Johnson to editor, *Philadelphia Daily News* (7 May 2012), 18.
[158] Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.
[159] Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.

deciding to sell.[160]

From time to time over the years, someone would suggest to Karloutsos that he should rent out the restaurant for dedicated events more often, because an event venue is a more lucrative type of operation than a restaurant. Although he had indeed rented it out, he had done so only a relatively handful of times and only on off nights or on portions of the property.[161] He believed it was his responsibility to maintain access to the site for the general public.[162]

When Karloutsos sold the Water Works Restaurant and Lounge in September 2015, however, an event venue is exactly what it became. Philadelphia Parks & Recreation awarded the operation to Cescaphe Event Group owner Joe Volpe. By December, Fairmount became Cescaphe's sixth location, catering only to weddings and private parties. The Engine House accommodated 250 guests in the main room, with up to 140 additional guests on the deck, as before. Volpe tented the Pavilion to enable it to accommodate up to 175 and erected a tent on the New Mill House deck for 400. The Caretaker's House was converted to a private bridal suite.[163]The Fairmount Water Works soon became as popular as an event venue as it had been as a restaurant.[164]

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[160] Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.
[161] Weddings, for example. See Kellie Patrick Gates, "Kate Devine & David Newman," *Philadelphia Inquirer* (18 Nov 2009), E3.
[162] Michael A. Karloutsos, former Owner-Operator, Water Works Restaurant and Lounge, telephone interview with author-editor, 15 Jun 2022.
[163] Michael Klein, "Table Talk," *Philadelphia Inquirer* (27 Aug 2015), F3; *Cescaphe* (2016), <www.cescaphe.com/blog/page/4>, accessed 29 Aug 2016; Alexandra Leshner, "Here Are All the Details About Cescaphe's Renovation of Water Works," *Philadelphia Magazine* (17 Dec 2015). Cescaphe opened in September 2015.
[164] A. D. Amorosi, "Lots of Ways to Welcome in 2016," *Philadelphia Inquirer* (25 Dec 2015), W10; Kellie Patrick Gates, "Angela Pasquale & Francis Rocchi," *Philadelphia Inquirer* (22 Jan 2017), H10; Kellie Patrick Gates, "Jaclyn Gardner & Kevin Donohue," *Philadelphia Inquirer* (25 May 2018), H12; Kellie Patrick Gates, "Allicia Zanghi & Jeffrey Frederick," *Philadelphia Inquirer* (29 Mar 2020), D8.

Although the Fairmount grounds and nearby areas did not receive much attention while the focus was on the buildings, there had been occasional activity, alterations, and improvements. One change was to the name of East River Drive, a major riverside thoroughfare with a popular parallel walking, jogging, and cycling trail.[165] On 13 March 1985, Fairmount Park Commission President F. Eugene (Fitz) Dixon abruptly announced that the roadway had been renamed Kelly Drive, after both John B. (Jack) Kelly, Jr., and his father John B. (Jack) Kelly, Sr., at the request of Mayor Wilson Goode.[166] The younger Kelly was a City Councilman and had died of a heart attack eleven days earlier while jogging after an early morning row on the Schuylkill River; the elder had died in 1960 while President of the Commission.[167]

A year later, South Philadelphia businessman Sal DiVito proposed that West River Drive be renamed for South Philadelphia restaurateur and nightclub owner Frank Palumbo, who had died in 1983.[168] When DiVito was rebuffed by the Fairmount Park Commission, he managed to convince City Council to pass an ordinance renaming the road in June 1987. City Solicitor Handsel B. Minyard, however, advised Mayor Wilson Goode that City Council did not have jurisdiction over West River Drive and Managing Director James S. White directed Streets Commissioner Harry M. Perks to leave the street signs as they were. Council members and other supporters of the name change would need to file suit in Common Pleas Court, declared

165 Today called the Schuylkill River Trail, it closely follows the roadway but diverges from it at Fairmount as it passes through the grounds of the Water Works before proceeding south along the river toward Center City Philadelphia.

166 Kelly Drive fell under the jurisdiction of The Fairmount Park Commission instead of the Philadelphia Department of Streets because it was located entirely within the bounds of Fairmount Park. See Vernon Loeb, "City Voids Naming Drive for Palumbo," *Philadelphia Inquirer* (9 Dec 1987), 33.

167 Walter F. Naedelem "Park Board Renames East River Drive to Honor John B. Kelly Jr. and Sr.," *Philadelphia Inquirer* (14 Mar 1985), 1f. Actress Grace Kelly was the daughter of the elder Kelly and younger sister of the younger.

168 Vernon Loeb, "City Voids Naming Drive for Palumbo," *Philadelphia Inquirer* (9 Dec 1987), 33.

Minyard, if they desired to pursue the matter further.

DiVito accused the Fairmount Park Commission of attempting to cover up its embarrassment over renaming East River Drive so quickly after the death of Jack Kelly, Jr. The Commission cited a policy it had adopted shortly before the City Council vote that prohibited the renaming of park streets after anyone deceased for fewer than ten years.[169] Commissioner Ernesta Ballard admitted that they had indeed acted too hastily in the earlier case. “The reason we adopted the guidelines that we did,” she said, “was so we wouldn’t be caught in that situation again.”[170] Despite further agitation in City Council,[171] West River Drive was never renamed for Frank Palumbo.

The Esplanade had been improved in 1988 with a pathway, interpretive sculptures, rejuvenation of the vegetation and tree cover, and improved access at both ends. *The Fisherman* had also been installed on a rocky point near the Esplanade’s midpoint. In January of 1996, however, the sculpture was knocked loose by debris borne by high water but was shortly recovered and remounted within six months.[172] In September of 1999, it was carried off again, by floodwaters from Hurricane Floyd. This time, however, it was lost for three years, its location unknown beneath the mud and silt at the bottom of the Schuylkill River.[173]

In 2001, a team of engineers and divers form GORCA Technologies, a research and

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[169] Perhaps it also had something to do with Palumbo’s racketeering and links to organized crime. Just a hunch.
[170] Vernon Loeb, “City Voids Naming Drive for Palumbo,” *Philadelphia Inquirer* (9 Dec 1987), 33.
[171] Vernon Loeb, “The Latest Word on the River Drives,” *Philadelphia Inquirer* (4 Mar 1988), 33.
[172] “Statue to Return,” *Philadelphia Daily News* (19 Jun 1996), 14.
[173] Philadelphia Water Department, *Press Release* (17 Jun 2004), <http://www.businesswire.com/news/home/20040617005633/en/ Philadelphias-Favorite-Fisherman-Regains-Place-Schuylkill-Esplanade>, accessed 9 Jun 2017; “Smithsonian Art Inventory Sculptures,” *Waymarking* (2016), <http://www.waymarking.com/waymarks/WMHTKZ_Station_no_6_Celebration_of_Water_Philadelphia_PA>, accessed 26 Aug 2016; and *Art Inventories Catalog, Smithsonian American Art Museum, Smithsonian Institution Research Information System (SRIS)* (2016), *<http://siris-artinventories.si.edu/ipac20/ipac.jsp?session=137640I87560K.2928&profile=ariall&source=~!siartinventories&view=subscriptionsummary&uri=full=3100001~!338468~!12&ri=1&aspect=power&menu=search&ipp=20&spp=20&staffonly=&term=Celebration+of+Water&index=.GW&uindex=&aspect=power&menu=search&ri=1&limitbox_1=LO01+=+ias>*, accessed 26 Aug 2016.

development company in Moorestown, New Jersey, proposed a demonstration project in which they would attempt to locate and raise the sculpture at no cost to the City of Philadelphia. In February 2002, they were given the go-ahead. Using a water- and ground-penetrating radar system, they successfully located and recovered “Philadelphia’s favorite and best-known fisherman,” 30 feet from where it had sat. After being repaired, *The Fisherman* was re-installed in its previous place in September 2004.[174]

From 1998 to 1990 the Pennsylvania Horticultural Society restored and enlivened the Azalea Garden, between Kelly Drive and the *Fountain of the Sea Horses*. A pergola entrance was constructed opposite the fountain and the Friends of the Azalea Garden was established to help with regular upkeep.[175] By the mid-1990s, maintenance of the garden cost $35,000 annually,[176] funded by volunteer contributions.[177] Today the Pennsylvania Horticultural Society still maintains the Azalea Garden under contract with Philadelphia Parks & Recreation.[178] The garden continues to be a popular venue for wedding photography as well as sunning and relaxation.[179]

In September 1998, the first new construction on Boathouse Row in nearly a hundred

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[174] Philadelphia Water Department, *Press Release* (17 Jun 2004), <http://www.businesswire.com/news/home/20040617005633/en/ Philadelphias-Favorite-Fisherman-Regains-Place-Schuylkill-Esplanade>, accessed 9 Jun 2017; “Smithsonian Art Inventory Sculptures,” *Waymarking* (2016), <http://www.waymarking.com/waymarks/WMHTKZ_Station_no_6_Celebration_of_Water_Philadelphia_PA>, accessed 26 Aug 2016; and *Art Inventories Catalog, Smithsonian American Art Museum, Smithsonian Institution Research Information System (SRIS)* (2016), *<http://siris-artinventories.si.edu/ipac20/ipac.jsp?session=137640I87560K.2928&profile=ariall&source=~!siartinventories&view=subscriptionsummary&uri=full=3100001~!338468~!12&ri=1&aspect=power&menu=search&ipp=20&spp=20&staffonly=&term=Celebration+of+Water&index=.GW&uindex=&aspect=power&menu=search&ri=1&limitbox_1=LO01+=+ias>*, accessed 26 Aug 2016.

[175] “When Was the First Azalea Garden Party?” *Ask PHS* (12 Feb 2021), <https://pennhort.libanswers.com/faq/251265>, accessed 10 Aug 2022.

[176] The equivalent of approximately $68,000 in 2022.

[177] Ron Avery, “Museum’s Landscape Not Worth Painting,” *Philadelphia Daily News* (15 Aug 1997), 8.

[178] Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.

[179] “Azalea Garden,” *The Cultural Landscape Foundation* (2020), <https://tclf.org/landscapes/azalea-garden>, accessed 12 Jan 2021.

years[180] was completed when Lloyd Hall was opened.[181] Located next to the Azalea Garden at 1 Boathouse Row,[182] at the intersection of Kelly Drive and Aquarium Drive,[183] the new 12,000-square-foot facility[184] replaced Plaisted Hall, a Tudor-style municipal landmark that was built in 1881[185] on the same spot and had been allowed to deteriorate to the point that it had become structurally unsafe. Condemned in 1992,[186] the dilapidated Plaisted Hall had been demolished in March 1994[187] and ground was broken for Lloyd Hall that fall.[188] Completion had been delayed by design changes and a 1997 carpenters' strike.[189]

Like its predecessor, Lloyd Hall functions a recreation center, not a boathouse, and is the only publicly accessible building on Boathouse Row.[190] It was named for state Senator James R. Lloyd, Jr., who had died in 1989. Lloyd was a Fairmount Park Commissioner and close aid of former Pennsylvania Governor Robert P. Casey.[191] Over half of the $4.5 million cost[192] was borne by a state grant, with the rest covered by the City of Philadelphia.[193]

Designed by the local Armstrong Kaulbach Architects,[194] and aligned with the axis of the Ben Franklin Parkway and Museum of Art, the recreation center featured a catering kitchen, roof

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180 The Sedgeley Club built their clubhouse at 15 Boathouse Row in 1902. All subsequent construction had been additions or modifications to existing structures. See "The Boathouse Past and Future," *Friends of Historic Sedgeley* (2022), <http://www.friendsofhistoricsedgeley.org/>, accessed 11 Aug 2022; *Sedgeley Club* (2022), <www.sedgeleyclub.org/>, accessed 11 Aug 2022.

181 "New Addition to Fairmount Park," *Philadelphia Inquirer* (13 Sep 1998), 1.

182 "Once, It Was the Public Boat House," *Philadelphia Inquirer* (8 Mar 1994), 1.

183 Today known as Waterworks Drive.

184 Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13.

185 Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13.

186 "Plaisted Hall's Demise Nears," *Philadelphia Daily News* (24 Feb 1994), 8; "Plaisted Hall is History," *Philadelphia Daily News* (8 Mar 1994), 26.

187 "Once, It Was the Public Boat House," *Philadelphia Inquirer* (8 Mar 1994), 1.

188 "Winter Blooms [editorial]," *Philadelphia Inquirer* (12 Dec 1994), 18.

189 Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13.

190 Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13.

191 Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13; "Lloyd Hall Rec Center," *Schuylkill Banks* (2022), <www.schuylkillbanks.org/landmarks/lloyd-hall-rec-center>, accessed 25 Aur 2022.

192 The equivalent of approximately $8.2 million in 2022.

193 "New Addition to Fairmount Park," *Philadelphia Inquirer* (13 Sep 1998), 1.

194 Today known as A K Architecture. See "About," *A K Architecture* (2022), <www.aka-rchitecture.com/about>, accessed 11 Aug 2022.

deck, outdoor terrace, provision for a café,[195] soaring exposed wood trusses over a basketball court, and two sets of public rest rooms, one set of which was accessible from the outside when the building was closed. Public internet wi-fi was also provided.[196]

A hidden, below-grade foundation for a 70-foot observation tower was constructed in the southwest corner of the property. At the time of construction, the cost of the future tower was estimated at an additional $600,000.[197] Planned to be connected to the main building by a skybridge from the roof deck, the tower has yet to be built.[198]

A year later the Fairmount Park Commission announced it intended to add parking spaces along Aquarium Drive between Lloyd Hall and the *Fountain of the Sea Horses* and along a disconnected portion of Fairmount Avenue between the fountain and Kelly Drive, totaling approximately 300 additional spaces in all. Commissioner Ernesta Ballard and Executive Director Bill Mifflin asserted that the additional spaces were needed in order to accommodate the increase in visitor traffic because of the new Lloyd Hall and rejuvenated Azalea Garden, as well as the expected increased when the planned restaurant at Fairmount would open in a few years. In addition to the head-in spaces, there would be an additional lot next to each roadway.[199]

The Philadelphia Historical Commission—whose approval was needed—and the Preservation Alliance of Greater Philadelphia were skeptical. Members of both groups acknowledged the need for more parking but winced at creating so much in such an historically sensitive area.[200] In response, the Fairmount Park Commission reduced the number of spaces to

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[195] When the café opened in 2006, it was managed by Michael Karloutsos and MAK Consulting, who also managed the Water Works Restaurant and Lounge. See "Boathouse Row Café Opens in Lloyd Hall," *Philadelphia Daily News* (23 May 2006), 16.

[196] Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13.

[197] The equivalent of approximately $1.1 million in 2022.

[198] Larry Fish, "The New Resident of the Row," *Philadelphia Inquirer* (19 Aug 1997), 13; "New Addition to Fairmount Park," *Philadelphia Inquirer* (13 Sep 1998), 1.

[199] Larry Fish, "Boathouse Area to Get Parking," *Philadelphia Inquirer* (30 Jan 1999), 19.

[200] Larry Fish, "Boathouse Area to Get Parking," *Philadelphia Inquirer* (30 Jan 1999), 19.

215 in order to reduce the footprint of the affected area. The Preservation Alliance supported the revised plan, and the Historical Commission gave its okay.[201] The expansion was constructed soon after.

With increased foot, bicycle, and vehicular traffic around Lloyd Hall, attention turned to the intersection of Kelly Drive, Aquarium Drive,[202] and Sedgley Drive at its doorstep. Configured as an unsignalized traffic oval since the Abraham Lincoln Monument was dedicated at its center in 1871, it had now become an impediment. Because the nearest pedestrian crossing of busy Kelly Drive was a third of a mile away, it was tempting to cross at the oval, but this was extremely dangerous.

From May 2001 to January 2002, the Philadelphia Streets Department reconfigured the crossing as a standard four-way signalized intersection with safe pedestrian crossings and protected left-turn lanes on all four legs. The memorial, depicting Lincoln as having just signed the Emancipation Proclamation, was restored and moved to a more dignified and accessible position in the northeast quadrant of the intersection. The total cost of the project came in at $3.9 million,[203] including $290,000[204] for the restoration and relocation of the Lincoln Monument.[205]

The structures of Fairmount continued to see incremental improvements. Recall that the Eagle Pavilion, on the Pier at the end of the Mound Dam, had been restored in 1989, but the work at that time did not include the replacement of the long-missing eagle atop the pinnacle of the roof. In June of 2001 the Eagle Pavilion received its eagle, a gilded, cast-bronze sculpture,

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[201] Larry Fish, "Waterworks Parking Wins Over Some Critics," *Philadelphia Inquirer* (26 May 1999), 29.
[202] Today known as Waterworks Drive.
[203] The equivalent of approximately $6.4 million in 2022.
[204] The equivalent of approximately $477,000 in 2022.
[205] Larry Fish, "Lincoln Will Be Moved Out of Traffic's Way," *Philadelphia Inquirer* (7 May 1998), B1, B6; Inga Saffron, "The Emancipation of the Lincoln Statue," *Philadelphia Inquirer* (13 Apr 2001), D1, D4; David O'Reilly, "Honest, Abe Has Been Moved on Kelly Drive," *Philadelphia Inquirer* (5 Jan 2002), B1f; "Abraham Lincoln," *Association for Public Art* (2022), <www.associationforpublicart.org/artwork/abraham-lincoln/>, accessed 11 Aug 2022.

funded in part by $10,000[206] from the Junior League, some of the last of the funds the organization had raised for Fairmount.

Fairmount Park Commission President Bobby Nix announced on 16 Feb 2005 that it was changing the name of West River Drive to Martin Luther King, Jr., Drive. Community leaders had been pushing for a significant tribute to King for decades; eventually public opinion coalesced on the historic but generically named roadway. The Commission responded when Mayor John Street publicly called for the name change in his budget address a month earlier.[207]

Since the 1960s, joggers and cyclists had enjoyed using a trail that ran along the Schuylkill River between East River Drive[208] and the water's edge, from Fairmount and Boathouse Row to the Manayunk neighborhood. The trail was extended to Valley Forge National Park along an abandoned rail line in the late 1970s.[209]

In 2004 the Fairmount Park Commission opened an extension of the paved pathway south from Fairmount along the east bank of the Schuylkill River through Center City to Locust Street.[210] In Center City the trail was part of a new linear park between the river and a busy freight rail line. At Locust Street, the park connected to the city street system via a railroad grade crossing.

First proposed in the modern era by Ed Bacon in 1947,[211] the Commission approved plans for a promenade park along the river in 1967.[212] It was expected that the $6.6 million

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[206] The equivalent of approximately $16,700 in 2022.
[207] Stephan Salisbury, "West River Drive Renamed for King," *Philadelphia Inquirer* (17 Feb 2005), B1, B7.
[208] Kelly Drive since 1985.
[209] "When the Sierra Club Met Frank Rizzo: How the Schuylkill River Trail Took Shape," *Bicycle Coalition of Greater Philadelphia* (24 Aug 2016), <https://bicyclecoalition.org/sierra-club-met-frank-rizzo-schuylkill-river-trail-took-shape/>, accessed 16 Aug 2022.
[210] "A Shining Moment for Schuylkill River Park Trail," *Philadelphia Inquirer* (21 May 2004), B6.
[211] Mark Davis, "Celebrating Schuylkill Park, In the Works After 300 Years," *Philadelphia Inquirer* (27 May 1997), B1, B5. William Penn is also said to have mentioned such an idea.
[212] Nicholas W. Stroh, "Park Approved for East Bank of Schuylkill," *Evening Bulletin* (12 Oct 1967), courtesy Special Collections Research Center, Temple University Libraries.

project[213] would be completed in time for the Bicentennial,[214] but by 1988 only a community park and garden had been constructed near its planned southern end.[215]

In 1992, local architect John Randolph formed the nonprofit Schuylkill River Development Council[216] to raise the necessary funds for the park's development and creation. The cost of the scaled-down project now reached $12 million[217] and was funded by a combination of federal transportation funds, City money, and contributions from foundations, corporations, and individuals.[218] Work on the initial phase, reconstruction of portions of the river bulkhead, got under way in early 1997[219] and was completed in 2001.[220]

After the preparatory work was finished, construction on the park itself then faced a series of setbacks. Each year construction seemed to be imminent, but was delayed by court squabbles over the eligibility of selected contractors and, most significantly, legal disputes with intransigent railroad officials at CSX Corporation, the owner of the rail line that paralleled the nascent trail.[221] The park and trail were eventually begun in late 2003 and finally completed in May 2004.[222] Even then, it didn't include the final landscaping; the total cost had escalated to $14.2 million[223] and money had run out before it could be finished.[224]

Landscaping or no, the long-anticipated park, now known as Schuylkill Banks,[225] was the

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[213] The equivalent of approximately $58.5 million in 2022.
[214] Nicholas W. Stroh, "Park Approved for East Bank of Schuylkill," *Evening Bulletin* (12 Oct 1967), courtesy Special Collections Research Center, Temple University Libraries.
[215] "About FSRP," *Friends of Schuylkill River Park* (2020), <www.fsrp.org/about>, accessed 31 Mar 2022.
[216] Today called the Schuylkill River Development Corporation.
[217] The equivalent of approximately $25.3 million in 2022.
[218] Mark Davis, "Celebrating Schuylkill Park, In the Works After 300 Years," *Philadelphia Inquirer* (27 May 1997), B1, B5.
[219] Mark Davis, "Celebrating Schuylkill Park, In the Works After 300 Years," *Philadelphia Inquirer* (27 May 1997), B1, B5.
[220] Inga Saffron, "Riverfront: Land of Opportunity," *Philadelphia Inquirer* (2 Nov 2001), E1, E10f.
[221] Inga Saffron, "Schuylkill Park Project Stymied," *Philadelphia Inquirer* (8 Jul 2002), A1, A7.
[222] Ronnie Polaneczky, "We Need Access to River Park Now," *Philadelphia Daily News* (21 May 2004), 12.
[223] The equivalent of approximately $22.8 million in 2022.
[224] Inga Saffron, "A Fine Park Now, and Even Better Later," *Philadelphia Inquirer* (25 Jun 2004), E1, E4.
[225] "Fitness Walking, Delaware Valley," *Philadelphia Inquirer* (6 Oct 2010), D9.

proverbial overnight sensation. Center City residents could easily access the trail via two stair towers and a set of bicycle ramps and jog or cycle up and down the Schuylkill River for recreation, while suburban residents could use the trail to commute to and from work. For Fairmount, this meant that what had been a sleepy corner of the city quickly became a thruway for foot and bicycle traffic. The Schuylkill River Trail,[226] as it was now called, stretched 23 miles from Center City to north of Valley Forge[227] and passed right through the South Garden. The Interpretive Center had opened the year before. The restaurant would open two years later. By 2010 the Fairmount Water Works would see and average of 16,000 passersby each month.[228]

Two boat docks were constructed on the Schuylkill River in 2005, one at Bartram's Garden and the other between Chestnut and Walnut Streets in Center City.[229] Suggested by Ed Bacon as part of his never-realized "21st Century Gateway" concept in 1993,[230] and advocated by the editorial staff of the *Philadelphia Inquirer* in 1995,[231] they were ultimately developed by the Schuylkill River Development Corporation.[232] The William Penn Foundation donated $2 million toward the project[233] and the City of Philadelphia and Bartram's Garden each contributed over $100,000.[234] The docks themselves cost about $500,000 apiece; the balance of the funds paid for

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[226] The system of linear parks along the river from Fairmount to (eventually) Fort Mifflin is called Schuylkill Banks. The trail itself is called the Schuylkill River Trail. The portion of the trail south of Fairmount is also planned to eventually become part of the East Coast Greenway. See "Discover the Hidden River," *Schuylkill Banks* (2022), <www.schuylkillbanks.org>, accessed 25 Aug 2022; "Pennsylvania," *East Coast Greenway* (2022), <www.greenway.org/states/pennsylvania>, accessed 25 Aug 2022.
[227] Don Sapatkin, "Cyclists' Escape Along Schuylkill," *Philadelphia Inquirer* (5 Jun 2004), B1, B3.
[228] "Happy Trails [editorial]," *Philadelphia Inquirer* (23 Jan 2010), A10; While there is no trail counter at Fairmount, a counter near Walnut Street in Center City provides a comparable number. Joseph R. Syrnick, President, Schuylkill River Development Corporation, telephone conversation with author-editor, 15 Aug 2022.
[229] Michael Currie Schaffer, "City Bets on River's Tourism Potential," *Philadelphia Inquirer* (23 Nov 2005), B5.
[230] Bob Warner, "Ed Bacon's Field of Dreams," *Philadelphia Daily News* (8 Jan 1993), 19f. Bacon's elaborate concept was composed of numerous elements. One small component was a system of public river access points stretching from the Fairmount Water Works to Fort Mifflin and up the Delaware River to Penn's Landing.
[231] "Hidden Worth [editorial]," *Philadelphia Inquirer* (25 Sep 1995), A11. (25 Sep 1995), A11.
[232] The Schuylkill River Development Council was reorganized with a board of directors and renamed the Schuylkill River Development Corporation 2002. See "About SRDC," *Schuylkill Banks* (2022), <www.schuylkillbanks.org/history>, accessed 16 Aug 2022.
[233] The equivalent of approximately $3 million in 2022.
[234] The equivalent of approximately $151,600 in 2022.

river-related educational programs and other public activities to draw visitors to Schuylkill River Park and the Schuylkill River Trail that ran through it.[235]

The two docks were intended to be part of a system of three, with the third at Fairmount. Envisioned was a circuit, linking programming at the Fairmount Water Works and Bartram's Garden, perhaps with a scheduled water taxi, allowing visitors to easily move between the two attractions and Center City.[236] At the time, the Fairmount Park Commission was in the process of designing the boat dock for Fairmount. It would have been located along the Esplanade just south of the Engine House; visitors would have embarked and disembarked via the South Garden. Projected to cost approximately $1 million,[237] the higher price tag was attributed to the difficult engineering constraints of the location, according to Stephanie Craighead, the Commission's Deputy Director for Planning.[238]

Despite the constructive collaboration that would be possible with a boating circuit on the Schuylkill River, however, the Fairmount Park Commission never built Fairmount's dock. As the design process moved forward, the projected cost escalated due to the difficulty of anchoring the dock to the walls of the South Garden and Esplanade, the challenging bi-level configuration of the proposed location, and the need to protect the structure from the heavy debris that periodically plows through this stretch of riverbank during recurring flood events. In the end, it was decided that the limited available funds were better spent elsewhere.[239]

The Fairmount Park Commission returned to the parking issue in 2006 when it approved

[235] Stephan Salisbury, "Penn Foundation Helps Fund 2 New Docks on the Schuylkill," *Philadelphia Inquirer* (18 Feb 2005), B5.
[236] Ron Goldwyn, "Link to New Park," *Philadelphia Daily News* (15 Jun 2004), R-9.
[237] The equivalent of approximately $1.5 million in 2022.
[238] Stephan Salisbury, "Penn Foundation Helps Fund 2 New Docks on the Schuylkill," *Philadelphia Inquirer* (18 Feb 2005), B5.
[239] Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.

a plan by the Philadelphia Museum of Art to construct a 440-car parking garage in the wedge of land between the Azalea Garden, the *Fountain of the Sea Horses*, and the museum's rear terrace with its Reilley Memorial. Although the museum had 300 spaces in the plaza surrounding the building, parking was notoriously tight on even a light day. During a high-turnout event, which could see up to 10,000 visitors in a day, it was next to impossible.

One problem, however, was that the facility would obliterate the disconnected stretch of Fairmount Avenue that held the 80 spaces legally reserved for the Water Works Restaurant. Art Museum CEO Gail Harrity flatly declared that there was no way to accommodate the restaurant's agreement. Fairmount Park Commission President Bobby Nix, though, made a declaration of his own—the restaurant lease was binding, and the Art Museum's plan would not be allowed to proceed unless alternative parking for the restaurant was made available beforehand.

A new lot on the north side of Kelly Drive, near the relocated Lincoln Monument and across from the Azalea Garden, was briefly entertained.[240] Eventually, however, Art Museum officials agreed to reserve a handful of spaces within the garage[241] and the Commission created an additional surface lot off Waterworks Drive,[242] between the *Fountain of the Sea Horses* and Lloyd Hall, similar to one it had proposed in 1999, and the garage project moved forward.

More thorny was the problem of how the garage might—or might not—fit in with its sensitive surroundings. Observers were skeptical that the parking garage could be anything but intrusive in such a context. *Inquirer* architecture critic Inga Saffron, for example, suggested a

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[240] Inga Saffron, "Park Takes Backseat to Cars," *Philadelphia Inquirer* (9 Jun 2006), E1.
[241] Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.
[242] Previously known as Aquarium Drive.

garage be constructed instead under Eakins Oval, on the eastern side of the museum.[243] The completed structure, however, won most people over.[244]

Although the garage had four levels, one could hardly tell. Designed by the Philadelphia architectural firm Atkin Olshin Schade[245] and CVM Engineers of nearby King of Prussia,[246] the $32 million facility[247] was partially buried and camouflaged under artful landscaping configured by noted Philadelphia-based OLIN Studio.[248] It had a one-acre green roof with a sculpture garden, trees, native plantings, meandering paths, and a fountain.[249] It was completed by local construction contractor LF Driscoll in 2009, under budget and six weeks ahead of schedule.[250]

The pace of improvements to Fairmount's grounds began to accelerate. The Junior League had earlier set aside $35,000[251] for the conservation and restoration of the Graff Memorial. Located in the South Garden, between the Engine House and the Central Marble Fountain, the marble structure had been erected by the Philadelphia City Councils in 1848, just over a year after Frederick Graff's death. Intended as an expression of civic gratitude for Graff's extraordinary contributions to the citizens of Philadelphia, it is historically significant as the "earliest known memorial for an engineer in America."[252]

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[243] For example, Inga Saffron, "Park Takes Backseat to Cars," *Philadelphia Inquirer* (9 Jun 2006), E1.
[244] For example, Inga Saffron, "Subtle Subterfuge," *Philadelphia Inquirer* (18 Sep 2009), E1.
[245] "Anne d'Harnoncourt Sculpture Garden," *Atkin Olshin Schade* (2022), <www.aosarchitects.com/case-study/anne-dharnoncourt-sculpture-garden>, accessed 11 Aug 2022.
[246] "Philadelphia Museum of Art, Parking Structure," *CVM* (2016), <http://cvmprofessional.com/service/structural-engineering/commercial-and-parking/philadelphia-museum-of-art-parking-structure/>, accessed 11 Aug 2022.
[247] Inga Saffron, "Subtle Subterfuge," *Philadelphia Inquirer* (18 Sep 2009), E1. The amount was the equivalent of approximately $44 million in 2022.
[248] "Anne d'Harnoncourt Sculpture Garden," *OLIN* (2022), <www.theolinstudio.com/anne-dharnoncourt-sculpture-garden>, accessed 11 Aug 2022.
[249] Inga Saffron, "Subtle Subterfuge," *Philadelphia Inquirer* (18 Sep 2009), E1.
[250] "The Philadelphia Museum of Art: Sculpture Garden and Parking Garage," *STO Building Group* (2022), <https://stobuildinggroup.com/projects/the-philadelphia-museum-of-art-sculpture-garden-and-parking-garage/>, accessed 11 Aug 2022.
[251] The equivalent of approximately $58,500 in 2022.
[252] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 4.

By the mid-twentieth century, however, as the grounds began to suffer from neglect the Graff Memorial saw a slow deterioration. The marble accumulated atmospheric soiling[253] and algae growth,[254] and approximately 75 percent of the joint mortar crumbled away.[255] All eight of the finials broke off and disappeared.[256] Although the original cast iron fence remained, portions were missing, and the grade of the surrounding ground had risen by nearly a foot, contributing to the iron fence's corrosion and disintegration.[257]

Attempts over the years to maintain the structure were haphazard at best. Sometime prior to 1981, for example, ersatz finials were created using a concrete material. Because the aggregate within the concrete was black, however, the color of the replacements was dark and did not match the rest of the memorial. Like the originals, at any rate, the newer finials were soon broken off and lost.[258]

Worse still, around the same time wood-framed windows were added to each of the four openings of the marble canopy which surrounds the Graff bust, likely in an effort to protect the sculpture. Unfortunately, this had the opposite effect. The frames were attached to the marble surface with caulk and glazing compound and—inexplicably—painted dark green. Except for the bust and its base, the marble surfaces inside the glass were painted the same color. The resulting enclosure created a micro-environment that accelerated deterioration of the bust and other

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[253] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 12f.
[254] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 13.
[255] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 13.
[256] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 11.
[257] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 11f.
[258] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 9, 11.

interior surfaces instead of slowing it.[259] It also created a tempting target for vandals;[260] the ground within the fence became littered with broken glass.[261]

In 1994, thieves smashed more of the glass and removed the Graff bust from its base. They didn't get very far with it, however, and dropped it about a hundred feet away where it was later found with its nose destroyed. Since then, the bust had been kept in storage for safe keeping.[262]

An investigation conducted by the Fairmount Park Historic Preservation Trust in 1997 detailed the work that needed to be done—remove the windows and green paint, clean the marble surfaces of accumulated grime and biological growth, conserve the marble surfaces in order to slow deterioration, reconstruct the missing finials, repoint all open mortar joints, lower the grade of the surrounding ground to the original level or raise the fence above the soil, repair the fence and reconstruct lost components, and paint the fence in the original white. The report also recommended reinstalling the Graff bust with a reconstructed nose, but waiting until the Fairmount Water Works site had been fully reactivated to replace the bust.[263]

The restoration was begun in 2005 and completed in 2006. Most of the recommendations from the earlier report were accomplished, including removal of the glazing, reconstruction of the finials, and a thorough cleaning. The repaired and reconstructed fence, however, was painted black instead of white. Finally, since the Interpretive Center was now open and the restaurant

[259] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 5, 10.
[260] Nels Nelson, "Beauty at Fairmount: Enjoy! Enjoy!" *Philadelphia Daily News* (18 Apr 1974), 26.
[261] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 11.
[262] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997), 5.
[263] "Frederick Graff Memorial, Fairmount Water Works: Documentation and Conservation Planning Report," *Fairmount Park Historic Preservation Trust* (Dec 1997). Executive summary at 1f; detailed recommendations at 17ff.

was projected to open soon, the Graff bust was reinstalled in its place of honor, albeit without a new nose.[264]

Just before Ernesta Ballard's death in August 2005, she helped create the Women for the Water Works, a volunteer committee of over a hundred women that raised money for Fairmount on behalf of the Fairmount Park Conservancy. Chaired by Leslie Anne Miller, one of the Conservancy's board members, the committee first met in November 2005[265] and was officially launched as a fundraising committee of the Conservancy in January 2006.[266] Its goal was to raise the final funds necessary to complete the last major portions of Fairmount's rejuvenation—the restoration of the South Garden, Cliffside Paths, and Mercury Pavilion, and the re-creation of the Rustic Pavilion.[267]

Whereas the Fund for the Water Works sought to attract funds from sources such as foundations and corporations in addition to individual donors, the Women for the Water Works raised money almost exclusively from individuals by its members opening their Rolodexes[268] and calling their friends, relatives, co-workers, acquaintances, and any other contacts they could conjure. Between 1998 and 2018, the Fund for the Water Works raised \$11.6 million,[269] while

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[264] Fairmount Park Historic Preservation Trust, *Graff Memorial: Fairmount Water Works South Garden* (2006); *Photographic record,* Fairmount Park Historic Resource Archives.

[265] William J. (Bill) Marrazzo, former Commissioner, Philadelphia Water Department (current President & CEO, WHYY), personal interview with author-editor, 14 Jul 2021; Marilyn Sprague, former colleague of Susan Myers, Junior League of Philadelphia, former Secretary, Fund for the Water Works, telephone interview with author-editor, 16 Oct 2021; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021.

[266] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021.

[267] William S. (Bill) George, CPA, former Treasurer, Fund for the Water Works, telephone interview with author-editor, 12 Nov 2021; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021, email correspondence with author-editor, 29 Sep 2022.

[268] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, telephone interview with author-editor, 20 Aug 2021. Rolodex® is a brand of desktop rotary card file contact information management system. See *Rolodex* (2023), <www.rolodex.com>, accessed 11 Jan 2023.

[269] Fund for the Water Works, *Monthly Treasurer's Report, Statement of Receipts and Disbursements: Total Cumulative Disbursements, 1 Apr 1998–31 Dec 2018* (Philadelphia: Dec 2018), 1. The amount was the rough

the Women for the Water Works raised $4.9 million between 2006 and 2008,[270] no small accomplishment for either group.

Together with the opening of the Water Works Restaurant and Lounge, this burst of fundraising inaugurated a productive time at Fairmount. In addition to the restoration of the Graff Memorial, numerous other long-anticipated projects were accomplished in 2006.

The restoration of the South Garden was completed that summer, at a cost of $2 million.[271] Closely following Frederick Graff's original plans from the 1830s, old and diseased London Plane trees were removed, young trees were planted, pathways were recut and laid with paving bricks, lawns were renewed, and reproduction period benches were installed.[272]

The Central Marble Fountain was restored as well. Like the nearby Graff Memorial, it also had deteriorated over the years, its marble components suffering the effects of weathering, vandalism,[273] and indifferent repairs.[274] It's most celebrated feature, the 1872 bronze reproduction of William Rush's 1809 sculpture *Allegory of the Schuylkill River*, had been given by the Fairmount Park Commission to the Philadelphia Museum of Art on long-term loan in

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equivalent of approximately $14.3 million in 2022.The four largest foundation donors were the Philadelphia Foundation (nearly $5.5 million), the Otto Haas Charitable Trust (nearly $1.2 million), the William Penn Foundation (over $1 million), and the Lenfest Foundation ($500,000). Far more numerous were contributions of $1000, $500, $100, down to $25, from private individuals.

[270] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022. The amount was the rough equivalent of approximately $6.7 million in 2022.

[271] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022. The amount was the equivalent of approximately $2.9 million in 2022.

[272] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record*, Fairmount Park Historic Resource Archives.

[273] Nels Nelson, "Beauty at Fairmount: Enjoy! Enjoy!" *Philadelphia Daily News* (18 Apr 1974), 26.

[274] Fairmount Park Historic Preservation Trust, *Marble Fountain: Fairmount Water Works South Garden* (Summer 2006).

1937.[275] Its waterplay hadn't functioned in decades, likely since the sculpture was removed.[276]

The basins were disassembled, intact marble components were conserved, and failed components were replaced. The basin was filled with water and the waterplay was returned to full functionality once more. A rustic rock base was recreated in the center of the fountain, but it would have to wait a while longer to receive an appropriate sculpture.[277] The total cost of the project was $750,000.[278]

The Central Cliffside Path was also restored in 2006. The path had been fenced off and inaccessible since the 1980s and for good reason—it was dangerous. Replacement railings along the top of the Stone Arch Bridge had long since disappeared, creating a serious fall hazard. Even where there wasn't a danger of falling, the paved surface on the steep slope had broken up and become a tripping hazard.

The Masonry Preservation Group of Pennsauken, New Jersey, cleared the path of vegetation, stabilized the bridge, repointed the stonework, and resurfaced the path with dark grey, hexagonal pavers. A team from the Robinson Iron Corporation, located in Alexander City, Alabama, reproduced the period decorative iron railing. Working from vintage photographs, since no plans of the originals had survived, the team recreated the railing in ductile iron, a more resilient material than the original cast iron. The project came in at $1 million.[279]

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[275] Allegory of the Schuylkill River, Provenance card, Philadelphia Museum of Art. The sculpture had graced the Central Marble Fountain since 1872. The loan was made official in 1940. See Temporary Receipt from Philadelphia Museum of Art, 22 Jul 1940, and Permanent Receipt from Philadelphia Museum of Art, 24 Sep 1940; both in possession of Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation.
[276] Photographic image at "Aquarium Fountain," *Philadelphia Inquirer* (21 Jun 1936), 88. The image is the latest verification of functionality the author-editor weas able to identify.
[277] Fairmount Park Historic Preservation Trust, *Marble Fountain: Fairmount Water Works South Garden* (Summer 2006).
[278] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022. The amount was the equivalent of approximately $1.1 million in 2022.
[279] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022;

The riverside façade of the New Mill House received a thorough examination and stabilization in 2007. Sheet piles were driven to create a cofferdam on the downstream side of the structure in order to provide access all the way down to the foundation. The masonry was cleaned and repointed, and the openings of the tail races were returned as closely as possible to their original appearance. The work was designed and supervised by Mark B. Thompson Associates.[280]

Two years after the Central Cliffside Path was restored, the North and South Cliffside Paths received the same treatment. The dense tangle of overgrowth which had rendered the serpentine course of the North Cliffside Path impassible at its midpoint was removed. A four-step, granite stair and two park benches were installed at this location in order to mitigate the steepness of the slope. The foot of the path was extended somewhat so that it could turn 90 degrees and intersect the Schuylkill River Trail on a direct alignment with the Forebay Bridge. This required the removal of the stone stair in this location, created by WPA workers in 1940, that had led from Waterworks Drive (originally Aquarium Drive) to the grassy slope behind the Art Museum. On the South Cliffside Path, a steep concrete stair that branched up and away near its midpoint was also removed.

Dark grey, hexagonal pavers and reproduction decorative iron railings were installed along both paths, matching those of the Central Cliffside Path. As with the earlier project, Masonry Preservation Group and Robinson Iron accomplished the work. When this was completed, all three Cliffside Paths had been restored as closely as possible to their original configuration and appearance—at least for those portions that remain today after the top of

Photographic record, Fairmount Park Historic Resource Archives. The amount was the equivalent of approximately $1.4 million in 2022.

[280] *Photographic record,* Fairmount Park Historic Resource Archives.

Fairmount was carved down in 1913 and 1914 in preparation for the construction of the Art Museum.[281]

Also in 2008, the Mercury Pavilion was restored to its appearance of 1872.[282] The roof was removed and placed on a temporary support structure nearby so that it could be more easily and safely renewed. The removal also facilitated the demolition of the steel poles and concrete base that had replaced the original wood components sometime in the mid-twentieth century. A new base, consisting of concrete footers, an octagonal wood structure, and a composite slat floor with benches, was constructed. New Roman Tuscan columns, made of wood and matching the originals, were crafted and installed. The roof, now covered with a metal sheath painted grey, was then attached to the new columns. Similar to the Central Marble Fountain, however, when the pavilion was completed it was still without the eponymous sculpture that had perched atop its roof until the 1930s.[283]

At the same time as this work was being accomplished, a connecting walkway was constructed between the Mercury Pavilion and the head of the Central Cliffside Path. One portion of the walkway was simple graded and compacted earth. A second length, however, was elevated off the ground a few feet as a bridge composed of concrete footers, structural steel, composite slat treaders, and steel safety railings. The area around the Mercury Pavilion was

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281 "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record*, Fairmount Park Historic Resource Archives. This is only true, of course, for those parts of the paths that remain today after the upper portion of Fairmount was regraded, prior to 1920, in preparation for the construction of the Art Museum.

282 This had been the recommendation in *Adaptive Reuse Feasibility Study for the Historic Fairmount Water Works* (John Milner Associates for Philadelphia Water Department, 1981).

283 "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record,* Fairmount Park Historic Resource Archives.

regraded for ease of handicapped access. The entire project also included interpretive signage.[284] The restoration of the Mercury Pavilion and the creation of the new connecting walkway were done by the Masonry Preservation Group.[285] Together, the North and South Cliffside Paths, connecting walkway, and Mercury Pavilion cost $2.5 million.[286]

The same year, a structure reappeared that had not been seen since 1883. Using vintage images, the Masonry Preservation Group[287] resurrected the Rustic Pavilion at a cost of $750,000.[288] Originally constructed in 1867 of tree limbs and branches,[289] it was now recreated in weathering steel that mimicked the earlier structure's Victorian architecture. The modern iteration should last considerably longer than its historical cousin's 16 years.[290] With an open lattice roof,[291] the new Rustic Pavilion has, like its nineteenth-century counterpart, become a popular feature overlooking the South Garden.[292] Upon its completion, it was dedicated in memory of Fitz Eugene Dixon, Jr., a long-time President of the Fairmount Park Commission and

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[284] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record,* Fairmount Park Historic Resource Archives.

[285] "Fairmount Water Works South Garden, Cliffside Paths and Pavilions," *Masonry Preservation Group* (2022), <http://mpgnj.com/portfolio-posts/fairmount-water-works-south-garden/>, accessed 30 Sep 2022.

[286] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022. The amount was the equivalent of approximately $3.4 million in 2022.

[287] "Fairmount Water Works South Garden, Cliffside Paths and Pavilions," *Masonry Preservation Group* (2022), <http://mpgnj.com/portfolio-posts/fairmount-water-works-south-garden/>, accessed 30 Sep 2022.

[288] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022. The amount was the equivalent of approximately $1 million in 2022.

[289] Water Department, *Chief Engineer's 1866 Annual Report* (31 Jan 1867), 36.

[290] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 122.

[291] This is not without historical precedent in this area. Recall that the Mercury Pavilion, a few paces to the north, featured a lattice roof from its construction in 1828 until probably 1862 when the roof was likely fully enclosed during a renovation that year. See Watering Committee, *1828 Annual Report* (22 Jan 1829), 10; Watering Committee, *1829 Annual Report* (11 Feb 1830), 9; Water Department, *Chief Engineer's 1862 Annual Report* (5 Feb 1863), 33.

[292] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record,* Fairmount Park Historic Resource Archives; "Rustic Pavilion, *Waymarking* (2022), <www.waymarking.com/waymarks/WMHRJY_Rustic_Pavilion_Philadelphia_PA>, accessed 5 July 2022.

Chairman of its Art Commission, who had died two years earlier at the age of 82.[293]

Mark B. Thompson & Associates provided oversight and design for the South Garden, Cliffside Paths, Mercury Pavilion, and Rustic Pavilion projects.[294] With the goal of the Women for the Water Works having been reached—seeing these projects completed and providing a $1.7 million endowment[295] for their ongoing maintenance—the committee happily disbanded shortly after its members held a celebration at Fairmount in September 2008.[296]

With fish ladders having been installed at Flat Rock Dam in 2005,[297] at Norristown Dam in 2008,[298] and at Black Rock Dam in 2009[299] (7, 16, and 28 miles upstream of Fairmount Dam respectively), migratory fish now had a virtually unimpeded path along the entire 135-mile length of the Schuylkill River. The fish, however, weren't passing through the Fairmount Fish Ladder in numbers that scientists had expected. The U.S. Fish and Wildlife Service estimated in 1999 that the Schuylkill River habitat could support between 700,000 and 800,000 American shad alone. In that event, 200,000 to 250,000 shad would be expected to use the ladder during

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[293] Thomas Fitzgerald, Andy Wallace, "Civic Leader Dixon is Dead," *Philadelphia Inquirer* (3 Aug 2006), A1, A15; John F. Morrison, "Area Sports Icon Fitz Dixon Dies," *Philadelphia Daily News* (3 Aug 2006), 9, 53; "Fitz Dixon Jr., Who Signed Dr. J, Dies at 82," *New York Times* (5 Aug 2006), <www.nytimes.com/2006/08/05/sports/basketball/05dixon.html>, accessed 5 Jul 2022. Dixon was heavily involved in state and local civic, cultural, and sporting affairs. He was perhaps best known to the local general public as the owner of the Philadelphia 76ers National Basketball Association franchise from 1976 to 1981.

[294] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022.

[295] The equivalent of approximately $2.3 million in 2022.

[296] Meg Holscher, Senior Director of Development, Fairmount Park Conservancy, email correspondence with author-editor, 29 Sep 2022.

[297] Bonnie L. Cook, "Watery Stairways to the Past," *Philadelphia Inquirer* (16 Mar 2008), <www.inquirer.com/philly/local/pa/chester/nabes/20080316_Watery_stairways_to_the_past.html>, accessed 8 Aug 2022.

[298] Bonnie L. Cook, "Watery Stairways to the Past," *Philadelphia Inquirer* (16 Mar 2008), <www.inquirer.com/philly/local/pa/chester/nabes/20080316_Watery_stairways_to_the_past.html>, accessed 8 Aug 2022.

[299] "Fishing," *Chester County Parks & Preservation* (2022), <www.chesco.org/4681/Fishing>, accessed 8 Aug 2022.

migration upstream.[300] While no one expected numbers as high as that, in 2006 only 16,850 fish of 26 species passed through, including a grand total of only 345 shad.[301] Something was clearly wrong.

It was time to take a second look at Fairmount's fish ladder. The U.S. Army Corps of Engineers created a team that examined the facility and found that the understanding of what attracts a fish to use a fish ladder had substantially improved since the Pennsylvania Fish and Boat Commission had built it in 1979. The Corps designed a reconfiguration and completed construction in 2009. The project cost over $3.3 million,[302] a third of which was covered by the Philadelphia Water Department.[303]

Operational improvements included pumping and piping additional water to the downstream fish entrance to increase attraction flow, construction of a water diversion system on the nearby section of the dam to prevent spillway water from competing with the entrance water, reducing the pool-to-pool elevation rise from 12 inches to 9 inches, increasing the width of the slots between each cell from 12 inches to 18 inches, and changing the configuration of the upstream fish exit to be perpendicular to the direction of water flow in order to reduce trash accumulation. In addition, a small amphitheater-type seating area to accommodate visiting group presentations was created, the chain-link security fence was replaced with a more aesthetically

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[300] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 5, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania.

[301] Joseph A. Perillo, Jr., *Evaluating the Use of Fairmount Dam Fish Passage Facility by Anadromous Fishes in the Schuylkill River, Philadelphia, Pennsylvania* (Dec 2006), 2, Table 1 at 18, courtesy Master of Environmental Studies Capstone Projects, University of Pennsylvania. This was despite the stocking of over a million shad fry into the river between 2000 and 2001. See Sandy Bauers, "Release of Fish Spawns Hope for Shad's Return to Schuylkill," *Philadelphia Inquirer* (5 Jun 2001), 71; Jane M. Von Bergen, "Monitoring the River's Health," *Philadelphia Inquirer* (2 Jun 2003), C1, C3.

[302] The equivalent of approximately $4.5 million in 2022.

[303] Lance H. Butler, Senior Scientist, Office of Watersheds, Philadelphia Water Department, email correspondence with author-editor, 17 Aug 2022.

appropriate one, and the landscaping was improved somewhat.[304] Use by migratory fish has improved since the modifications were made,[305] with the current annual count of American shad hovering around 2,300, up more than 660% since 2006.[306]

On the opposite side of Fairmount's grounds, a skate park was opened in May 2013. Called Paine's Park, after Revolutionary War-era pamphleteer and sometime Philadelphian Thomas Paine,[307] the well-received recreational space[308] was built between Martin Luther King, Jr., Drive, a CSX rail line, and the Schuylkill River Trail, just below Fairmount and the Art Museum. The park was conceived in 2002 after City officials banned skateboarding in Center City's Love Park[309] when that park had begun to suffer damage from the activity, but it took 11 years of planning, donation of the land by the City of Philadelphia, and $4.5 million in fundraising[310] by Franklin's Paine Skatepark Fund for construction to be realized.[311]

The site had been the location of an automobile junkyard in the 1950s and a grassy, wooded area since then. When the junkyard was eliminated, there were plans to build a parking lot for the Art Museum in its place, but fortunately that had never materialized. The new park meant more trail traffic through the grounds of Fairmount.

Later in 2013 the Department of Parks & Recreation completed a year-long restoration of

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304 U.S. Army Corps of Engineers, *Finding of No Significant Impact (FONSI): Fairmount Dam Fish Ladder Project* (4 Feb 2004).
305 Mike Newall, "Fish-Counter's Goal: Adding to Shad Numbers," *Philadelphia Inquirer* (15 May 2016), B1, B6
306 Joseph A. Perillo, Jr., Staff Scientist, Bureau of Laboratory Services, Philadelphia Water Department, email correspondence with author-editor, 22 Aug 2022.
307 "Paine's Park," *The Constitutional Walking Tour* (17 Aug 2015), <www.theconstitutional.com/blog/2014/12/23/paine's-park-–-riverfront-skatepark>, accessed 17 Mar 2022.
308 "Wow, Philadelphia Did Something Smart!" *Quarter Snacks* (22 May 2013), <https://quartersnacks.com/2013/05/first-look-paines-skatepark-in-philadelphia/>, accessed 17 Mar 2022; "Paine's Park," *Philly Skates (Franklin's Paine)* (2022), <http://bockaroundtheblock.com/phillySkates/paines.html>, accessed 12 Apr 2022.
309 Inga Saffron, "Common Ground," *Philadelphia Inquirer* (17 May 2013), D1, D3; "Paine's Park," *The Constitutional Walking Tour* (17 Aug 2015), <www.theconstitutional.com/blog/2014/12/23/paine's-park-–-riverfront-skatepark>, accessed 17 Mar 2022.
310 The equivalent of approximately $5.7 million in 2022.
311 Inga Saffron, "Common Ground," *Philadelphia Inquirer* (17 May 2013), D1, D3.

the *Fountain of the Sea Horses*. The travertine marble fountain, donated by the Italian government, was intended for Philadelphia's Sesqui-Centennial International Exposition in 1926 but was shipped too late to arrive in time for that celebration. It was installed instead in 1928 within a traffic circle at the northern end of Fairmount's grounds. It had deteriorated over the years and by the 1960s the waterplay no longer worked.[312] Its condition was so poor that in 1969 the Fairmount Park Commission recommended its removal so it wouldn't be an eyesore for the expected increase in visitors during the upcoming Bicentennial.[313] In 1971, however, the Order of the Sons of Italy and Canada began raising funds for repairs[314] and a $100,000 rehabilitation[315] was finished in time for the national celebration. Cast concrete sections replaced broken tails and missing wings, the water play was restored, new lighting was installed, and marble bollards were placed around the basin for protection.[316]

By 1980, the fountain had stopped working again when the pump chamber flooded in a storm.[317] The waterplay was restored again at some point but was shut down once more in 2006 after the drain to the river became blocked.[318]

The 2013 restoration cost $1.7 million dollars,[319] split 50-50 by a grant from the Pennsylvania Department of Conservation and Natural Resources and funds from the City of Philadelphia, and was accomplished by Materials Conservation Co., a local firm. The fountain

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[312] Ruth Seltzer, "They're Giving a Present to Fairmount Park," *Philadelphia Inquirer* (4 Jun 1967), 107.
[313] Dorothy S. Bird, "Italy's Gift Fountain May Get Her Sons' Aid," *Evening Bulletin* (1 Aug 1971), courtesy Special Collections Research Center, Temple University Libraries.
[314] Dorothy S. Bird, "Italy's Gift Fountain May Get Her Sons' Aid," *Evening Bulletin* (1 Aug 1971), courtesy Special Collections Research Center, Temple University Libraries.
[315] The equivalent of approximately $520,000 in 2022.
[316] Philip Weiss, "If They Could, Horses Would Cry a Fountain," *Evening Bulletin* (18 Sep 1980), courtesy Special Collections Research Center, Temple University Libraries.
[317] Philip Weiss, "If They Could, Horses Would Cry a Fountain," *Evening Bulletin* (18 Sep 1980), courtesy Special Collections Research Center, Temple University Libraries.
[318] Ashley Hahn, "Italian Fountain Restored, Getting Ready to Splash Again This Summer," *WHYY: PlanPhilly* (31 May 2013), <https://whyy.org/articles/italian-fountain-restored-getting-ready-to-splash-again-this-summer/>, accessed 9 Aug 2022.
[319] The equivalent of approximately $2.1 million in 2022.

was completely disassembled, all 40 tons of it. The concrete parts were removed and replaced with newly carved travertine from Turkey. All surfaces were cleaned to remove environmental deposits and biological growth. New plumbing, lighting, and electrical systems were installed and the landscaping surround was substantially improved.[320]

By this time, virtually all of the boxes on Fairmount's restoration checklist had been checked off. The exteriors and decks of the Engine House, Old Mill House, New Mill House, and Pier had been restored. The Mound Dam had been stabilized. The Pavilion, North Entrance House, and South Entrance House gleamed. The Eagle Pavilion, crowned again with its eagle, beckoned strollers to the eastern end of Fairmount Dam. The Esplanade entreated the more adventurous to clamber down close to the water. Visitors hiked up and down the Cliffside Paths. The South Garden promised a relaxing view of the river or a grassy respite from a jog along the Schuylkill River Trail. The basin of the Central Marble Fountain flowed with water. The Graff Memorial invited visitors to contemplate the groundbreaking achievements of the great man. A popular restaurant was operating in the Engine House and the Interpretive Center was delighting adults and children alike with its water-themed activities and historical interpretation within a portion of the Old Mill House and lower level of the Engine House. The Mercury Pavilion and Rustic Pavilion once more offered grand vistas from atop the Cliffside Paths.

Two things were still missing, however. All involved believed the restoration of the Fairmount Water Works would not be complete until two pieces of sculpture were returned in some fashion to their original locations—*Mercury,* atop the Mercury Pavilion, and *Allegory of*

[320] Philadelphia Parks & Recreation, *Italian Fountain Restoration* (2013); Ashley Hahn, "Italian Fountain Restored, Getting Ready to Splash Again This Summer," *WHYY: PlanPhilly* (31 May 2013), <https://whyy.org/articles/italian-fountain-restored-getting-ready-to-splash-again-this-summer/>, accessed 9 Aug 2022; Megan Lydon, "Historic City Fountain Flows Back Into Life," *Philadelphia Inquirer* (12 Sep 2013), B4. "Fountain of the Sea Horses," *Materials Conservation Co.* (2022), <https://mconservation.squarespace.com/fountains/fountain-of-the-sea-horses>, accessed 10 Aug 2022; The original misspelled "Indipendence," carved in Italy on the coping stones of the basin was wisely not corrected.

the Schuylkill River, in the middle of the Central Marble Fountain.[321]

Mercury had been carved from Spanish cedar[322] by William Rush and installed in 1829.[323] *Allegory of the Schuylkill River* was an 1872 bronze reproduction of Rush's original Spanish cedar sculpture from 1809.[324] The two works had been missing from the grounds of Fairmount since they were given on long-term loan to Philadelphia Museum of Art in 1937 and 1940 respectively.[325] Although as public art they were originally intended to be enjoyed freely by visitors to Fairmount, for decades they were exhibited in the museum only intermittently, and one had to pay to see them in any event.[326]

In 2012, D. Dodge Thompson, Chief of Exhibitions at the Smithsonian Institution's National Gallery of Art, in Washington, D.C., initiated a project to replace some form of the two sculptures.[327] His interest in the Fairmount Water Works and its artwork dated to the 1970s when he was Administrator of Curatorial Affairs at the Philadelphia Museum of Art. He developed a love for the sculpture of William Rush that led him to become a recognized expert in the artist's

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[321] A third, once-prominent sculpture was *Diana,* situated for decades near the foot of the Central Cliffside Path. Heavily vandalized over the years, she disappeared sometime in the mid- to late-20th century. Efforts to locate the sculpture, if it still exists at all, have been unsuccessful.

[322] Spanish cedar. See description at *Mercury,* 311-1993-1 (8 Aug 2006), archives of Philadelphia Museum of Art.

[323] Watering Committee, 1829 Annual Report (11 Feb 1830).

[324] Watering Committee Papers (1809), City of Philadelphia Archives; quoted in Charles Coleman Sellers, "William Rush at Fairmount," Sculpture of a City: Philadelphia's Treasures in Bronze and Stone, Nicholas Wainwright, ed. (New York: Walker Publishing Co. for Fairmount Park Art Association, 1974), 9, 344n7.

[325] Single provenance card for accessions 12-1937-1, *Allegory of the Schuylkill River in Its Improved State,* 12-1937-2, *Allegory of the Water Works,* 12-1937-3, *Wisdom,* 12-1937-4, *Justice,* and 12-1937-5, *Mercury* (29 Nov 1937); provenance card for accessions 29-1940-1, *Allegory of the Schuylkill River,* (1940), both in archives of Philadelphia Museum of Art; Temporary Receipt from Philadelphia Museum of Art, 22 Jul 1940; Permanent Receipt from Philadelphia Museum of Art, 24 Sep 1940, both in Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation.

[326] Provenance card for accession 12-1937-5, *Mercury* (29 Nov 1937, and updated thereafter); provenance card for accessions 29-1940-1, *Allegory of the Schuylkill River* (1940), both in archives of Philadelphia Museum of Art. The Philadelphia Museum of Art also loaned *Mercury* for a time in 1979 to the Atwater Kent Museum. *Allegory of the Schuylkill River* was loaned from April through November 1955 to the Pennsylvania Academy of Fine Arts for exhibition by the U.S. State Department in Madrid, Florence, Innsbruck, Stockholm, and Brussels; upon its return it was found to have suffered slight abrasion damage from its packing during shipment.

[327] D. Dodge Thompson to Timothy Rub (CEO, Philadelphia Museum of Art) and Theresa Stuhlman (Preservation & Development Administrator, Philadelphia Parks & Recreation), 26 Jun 2012.

work.[328]

It was acknowledged from the outset that reproductions would need to be made. Both pieces were historic and the risk of exposure to potentially destructive vandalism was too great. *Mercury,* in any case, had deteriorated to the point that it would have fallen apart had it been remounted out of doors. It was missing its feet, cape, caduceus,[329] and part of the wings on its helmet. Any effort to "restore" it would have required such radical modification to the remaining material that much of the integrity of Rush's original work—so valuable to historians—would have been destroyed.

Stratton Sculpture Studios, located in the Frankford neighborhood of Philadelphia, was selected to reproduce the sculptures. Husband and wife Shane and Julia Stratton performed the work, with assistance from Pavel Efremoff. Fittingly, the Strattons got their start in the 1990s at the Pennsylvania Academy of the Fine Arts, the institution which William Rush helped to found in 1805.[330] Two staff members from the Philadelphia Museum of Art, Sally Malenka, Senior Decorative Art and Sculpture Conservator, and Kathy Foster, Senior Curator of American Art and Director of the Center for American Art, assisted the Strattons in working with the originals housed at the museum and advised the team throughout the process. Funding came from a $100,000 grant[331] from the William B. Dietrich Foundation.[332]

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[328] See for example D. Dodge Thompson, "The Public Work of William Rush: A Case Study in the Origins of American Sculpture," William Rush, American Sculptor, Linda Bantel, ed., (Philadelphia: Pennsylvania Academy of the Fine Arts, 1982). Recall that Thompson had also been instrumental in arranging and finding the funds for the Fiberglas™ reproductions of William Rush's original wood Allegory of the Schuylkill River in its Improved State and Allegory of the Water Works in 1979. These reproductions still grace the North and South Entrance Portals today.
[329] The sculpture shows evidence of once having a staff. Hermes (in Greek mythology) and Mercury (in Roman) were often depicted with a caduceus, a staff with dual intertwined serpents and sometimes with wings.
[330] "Bios," Stratton Sculpture Studios (2022), <https://strattonsculpturestudios.com/read-me>, accessed 11 Jul 2022.
[331] The equivalent of approximately $130,000 in 2022.
[332] Lucy Strackhouse, former Senior Director of Preservation & Project Management, Fairmount Park Conservancy, telephone conversation with author-editor, Feb 2018.

The 1872 version of *Allegory of the Schuylkill River* had been cast in lead bronze in two pieces, with the top and bottom riveted together and the rivets ground flush. For the reproduction, silicon bronze was chosen because the material is harder, stronger, less porous, and more resistant to corrosion than ordinary bronze. It can also be welded.

Inspection of the 1872 original revealed an undocumented repair to the bird's bill that resulted in a small but visible ripple.[333] The crease was not reproduced. Nor was the two-piece construction. Instead, the sculpture was reproduced in a single piece.

The reproduction was created using the lost wax method. A rubber mold was made of the original. The rubber mold was then used to create a temporary wax reproduction of the original. A ceramic mold was made of the wax model. The bronze reproduction was created using the ceramic mold.

A more detailed description, though, conveys the enormous amount of labor that went into the work. The original sculpture was first covered with ordinary plastic wrap. The layer of plastic wrap was then covered with a quarter-inch-thick layer of clay. Thin metal shims were placed into the clay to divide it into approximately 20 sections called "mother molds." The 20-odd clay mother molds were then removed from the plastic wrap and the plastic wrap was removed from the sculpture.

A thin protective layer of petroleum jelly was next applied to the original sculpture. The clay mother molds were placed back onto the original sculpture, with a roughly quarter-inch gap between the clay molds and the sculpture. All of the seams between the separate mother molds were sealed with plaster. Approximately 120 pounds of room-temperature liquid rubber was poured into the space between the sculpture and the clay mold and was allowed to set. After two

[333] Shane Stratton, Principal, Stratton Sculpture Studios, telephone interview with author-editor, 6 Jan 2018. No evidence of the slight shipping damage from the 1955 European tour was discerned.

days, the clay-backed rubber mold was removed from the original sculpture.

After the rubber mold was reassembled, wax was poured into it. A microcrystalline petroleum product with a carnauba additive was used instead of beeswax because it pours better and is less brittle when cooled. After the wax had cooled, the rubber mold was removed, revealing a quarter-inch-thick wax reproduction of the original, the color of milk chocolate and weighing approximately 50 pounds.

After being approved by stakeholders, the wax positive was cut into five sections. Wax rods were attached to the sections; in the final portion of the process, these would function as vents. Each section of the wax positive was coated with liquid clay and stucco and the material was allowed to dry. This material would become the final mold. Over six days, approximately 12 layers of raw ceramic were then built up over the clay and stucco molds to create a weight-bearing backing. The ceramic shells, with their clay and stucco, were then fired in a kiln at a temperature of 2,000° Fahrenheit.[334] In the kiln, the ceramic, clay, and stucco hardened and the wax melted and drained out of the shells. After the now-hollow shells cooled, they were reinforced on the outside with cement.

While each of the shell molds were pre-heated, the bronze material was heated to 2,100° Fahrenheit[335] and poured into the ceramic shell molds. The locations of the wax rods were now hollow tubes which vented air to allow for complete filling of the molten bronze. After cooling for approximately 24 hours, the ceramic molds were broken up with hammers and chisels, revealing the final bronze sections. The sections were then welded together with bronze chasing to match the surrounding material.

The entire golden-brown bronze sculpture was blasted with glass beads and cupric nitrate

[334] Approximately 1,100° Celsius.
[335] Approximately 1,150° Celsius.

was applied to the surface to chemically create a green patina, a little darker than the color of the Statue of Liberty. The surface was then sealed with several layers of hard, clear paste wax. To permit a jet of water from the bird's bill, it was fitted with a brass nozzle. A length of white PEX[336] tubing provided a connection to plumbing within the base of the fountain.

The reproduction *Allegory of the Schuylkill River* weighs 475 pounds. The greatest challenge the Stratton team faced was molding the tricky area between the head and the body of the bird, as well as the drapery of the skirt with its deep relief and complex shapes.[337]

The same team reproduced *Mercury*. The condition of the original wood sculpture meant that it could not withstand the rigors of reproduction by the lost wax method, however, so a technologically sophisticated alternative was employed. The original was digitally laser-scanned and a foam reproduction was created by milling numerous foam blocks using a computer-controlled die cutting machine. The milled blocks were then glued together and the seams blended by hand. Molds made from the foam reproduction were then used to create a quarter-inch-thick preliminary sculpture using marine-quality resin that was a pale green in color.

Portions of the original's feet survive, enough that the Stratton team could refashion them, using artistic judgment and Shane's own feet as models. The helmet's wings were also recreated, as were a few other bits such as the pinky of the right hand. No documentation of the appearance of the caduceus or cape had been discovered, and period images were inconclusive, so with the approval of the stakeholders the team did not attempt to reproduce them.

The resin surface was coated with a gold primer and a top coat of a durable, industrial-

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[336] PEX, cross-linked polyethylene plastic, is a flexible polymer material that is durable as long as it is not exposed to ultraviolet light. See "Cross-Linked Polyethylene (PEX)," *Plastics Pipe Institute* (2022), <www.plasticpipe.org/BuildingConstruction/BuildingConstruction/PEX.aspx>, accessed 12 Jul 2022.

[337] Shane Stratton, Principal, Stratton Sculpture Studios, telephone interview with author-editor, 6 Jan 2018; *Photographic record,* Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation; *Photographic record,* Historical Archives, Philadelphia Water Department.

grade, glossy white paint. The finished *Mercury* is two-thirds life size, like the original, and weighs in at 40 pounds, slightly less than the original. The heaviest component is the one-inch-diameter stainless steel mounting rod.[338]

On the morning of 20 December 2017, the reproduction *Allegory of the Schuylkill River* was hoisted by a crane and installed in the center of the Central Marble Fountain in the South Garden. As soon as the weather permitted, sometime in April of the following year, water was supplied to the fountain. The marble basin had been filled with water and small courses had played from the base since 2006, of course, but now a jet of water gushed from the bird's bill, cascading down around the elegant form of the sculpture for the first time in over 80 years.[339]

On the afternoon of Friday, 9 February 2018, *Mercury* was carried up a ladder and installed atop the finial of the roof of the Mercury Pavilion. Lit by dual lights fixed a few feet below, the sculpture presides once more over the grounds of Fairmount.[340] With this, the restoration and reactivation of the Fairmount Water Works and its grounds was considered complete.

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[338] Shane Stratton, Principal, Stratton Sculpture Studios, telephone interview with author-editor, 6 Jan 2018; *Photographic record,* Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation; *Photographic record,* Historical Archives, Philadelphia Water Department.

[339] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record,* Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation; *Photographic record,* Historical Archives, Philadelphia Water Department.

[340] "Capital Projects: Water Works South Garden and Cliff Paths," *Fairmount Park Conservancy* (2022), <https://myphillypark.org/what-we-do/capital-projects/water-works/>, accessed 3 May 2022; *Photographic record,* Fairmount Park Historic Resource Archives, Philadelphia Parks & Recreation; *Photographic record,* Historical Archives, Philadelphia Water Department.

EPILOGUE

...it is desirable that the beautiful buildings...be preserved for all time as a fine example of the earlier architecture and methods of supplying water to the people of Philadelphia...

—City Ordinance, 16 March 1911[1]

The Fairmount Water Works continues today to be a vibrant place. A steady stream of cyclists, joggers, and casual walkers pass through the grounds along the Schuylkill River Trail. Some meander over to the balustrade in the South Garden or out to the Eagle Pavilion and Pier to view the river. Activity increases, naturally, during the warmer months of the year. During nice weather, people can be found relaxing on blankets in the South Garden or sunning themselves in the nearby Azalea Garden or in the grassy area that was formerly the outer Forebay.

The Fairmount Dam is still owned by the City of Philadelphia and continues to be a working structure. The water it impounds in the Fairmount Pool is the source of water for two intake facilities, the Belmont and Queen Lane Stations, two and four miles upstream of the dam respectively. Together, these installations draw a combined 140 million gallons of water per day and serve approximately 600,000 customers, roughly 38 percent of the city's population.[2]

Philadelphia Parks & Recreation owns and manages Fairmount's buildings and grounds. The Philadelphia Water Department continues to operate the Interpretive Center within the Old

[1] "An Ordinance to provide for the construction, installation and maintenance of a public aquarium and museum in the Fairmount Water Works," *Journal of the Common Council of the City of Philadelphia, from December 1, 1910, to May 25, 1911,* Vol. II (16 Feb 1911), 598ff. Mayor John E. Reyburn signed the ordinance on 16 Mar.
[2] Philadelphia Water Department, *Belmont Intake: Public Summary* (undated); Philadelphia Water Department, *Queen Lane Intake: Public Summary* (undated).

Mill House, New Mill House, and lower level of the Engine House. Cescaphe continues to operate its event venue out of the Engine House and across the decks of the Mill Houses under a concession contract with Philadelphia Parks & Recreation.

A new concession recently joined Cescaphe at Fairmount. During the warmer months a fenced, outdoor beer garden called Parks on Tap operates at the river's edge just above Fairmount Dam. Located on the lawn and among the trees between the Mound Dam, the *Fountain of the Sea Horses,* and Lloyd Hall, it is open to adults and accompanied minors during evenings on weekends and afternoons and evenings on most weekdays and offers local craft beer, wine, cocktails, non-alcoholic beverages, and locally sourced light food and snacks.[3]

Recreation Commissioner Kathryn Ott Lovell has led Philadelphia Parks & Recreation since 2016.[4] Stephanie Craighead served for many years as Director of Planning, Preservation, & Property Management before retiring in February 2022. Leigh Ann Campbell now serves in that position. Campbell worked on the restoration of the *Fountain of the Sea Horses* for OLIN Studio prior to working at the Pennsylvania Horticultural Society. Theresa Stuhlman continues as Preservation and Development Administrator, reporting to the Director of Planning, Preservation, & Property Management.[5]

At the Philadelphia Water Department, Joanne Dahme retired as General Manager of Public Affairs in 2019. The current Water Commissioner, Randy Hayman, appointed Glen Abrams to the new position of Deputy Commissioner for Public Affairs.[6] Karen Young

[3] "Welcome," *Parks on Tap* (2023), <www.parksontap.com>, accessed 11 Jan 2023.
[4] "Executive Staff," *Philadelphia Parks & Recreation, City of Philadelphia* (25 Apr 2019), <www.phila.gov/departments/philadelphia-parks-recreation/about/executive-staff/>, accessed 25 Jul 2022.
[5] Theresa Stuhlman, Preservation and Development Administrator, Philadelphia Parks & Recreation, interview with author-editor, 15 Dec 2022 and 9 Jan 2023.
[6] Joanne Dahme, former General Manager, Public Affairs, Philadelphia Water Department, telephone conversation with author-editor, 19 Jul 2021. The position was changed from General Manager to Deputy Commissioner shortly before Dahme's retirement, but she chose to remain known professionally by the older title.

continues as Director of the Fairmount Water Works Interpretive Center. The enduring Drew Brown still serves as Public Education Manager, although he is anticipated to retire soon.

Improvements to the grounds of Fairmount have continued. After nearly a year and half of construction, Parks & Recreation officials unveiled in 2018 the Fairmount Water Works Trail and Boardwalk, a 380-foot loop of elevated walkway that takes visitors over the river bulkhead and out to a portion of the silt island between Fairmount Dam and Boathouse Row. The $4.2 million project[7] included the dredging of a channel between the island and the bulkhead and the construction of sunning structures for eastern redbelly turtles, currently an endangered species. With benches for relaxing, the boardwalk provides vistas of the Schuylkill River and the Fairmount Water Works never before available.[8]

The Schuylkill River Trail now stretches 60 miles, from Christian Street in South Philadelphia to Reading, with an additional 60 miles of branching trails in Philadelphia's Wissahickon Valley and in Montgomery and Chester Counties. Partly because of the increased connectivity, there is now an average of 40,000 trips per month where the trail passes through the grounds of the Fairmount Water Works,[9] up from 16,000 in 2010.[10] Two segments projected to be completed in 2023 and 2025 will push southward and connect with existing sections to extend the trail past Bartram's Garden to 61st Street near Passyunk Avenue in Southwest Philadelphia,[11] so the number of trail users passing through Fairmount will likely continue to increase.

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[7] The equivalent of approximately $4.9 million in 2022.

[8] Frank Kummer, "A Final Big Step," *Philadelphia Inquirer* (17 Oct 2018), B1; Frank Kummer, "Elevated Expectations," *Philadelphia Daily News* (17 Oct 2018), Z3.

[9] Joseph R. Syrnick, President, Schuylkill River Development Corporation, telephone conversation with author-editor, 15 Aug 2022. Although there is no trail counter at Fairmount, a nearby counter in Center City provides a comparable figure. This figure represents the number of trips, not individual people; repeat and round trips are included. This also represents an average throughout the year; naturally, numbers are higher from Spring through Autumn and lower during Winter.

[10] "Happy Trails [editorial]," *Philadelphia Inquirer* (23 Jan 2010), A10;

[11] Joseph R. Syrnick, President, Schuylkill River Development Corporation, telephone conversation with author-editor, 15 Aug 2022.

Less positively, in March 2020 the region began to experience the effects of the global COVID-19 pandemic. Both Cescaphe and the Interpretive Center shut down as Governor Tom Wolf and Mayor Jim Kenney shuttered state and city offices and issued draconian stay-at-home orders that forced many businesses to close for months. When people eventually ventured out, they were urged to wear masks and practice "social distancing."[12] By the summer of 2021, Cescaphe began to schedule events in the open air on the decks and the staff of the Interpretive Center started organizing outdoor visitor activities.[13] By the following summer, COVID-19 fears had largely subsided.

The Fairmount Water Works has weathered many difficulties in the past few years, often literally. One of the ongoing challenges, as we have seen, has to do with its location in a flood zone. Because the level of the flood plain is roughly at the level of the decks, and the buildings are within the tidal portion of the Schuylkill River, the space within the Interpretive Center experiences flooding from time to time. Preparing for, and recovering from, flood events is a crucial part of the center's planning.

The staff of the Interpretive Center continuously needs to monitor short- and long-range weather forecasts and be ready to implement incremental flood preparation actions. If the water level of the Schuylkill River exceeds a certain height at the Water Department's Queen Lane intake station, a little over four miles upstream from Fairmount, workers at the station notify the Interpretive Center's facility manager and director, who then implement the flood response plan.

If a flood event is determined to be likely, staff members begin to move electronics,

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[12] Harold Brubaker, Christian Hetrick, and Erin Arvedlund, "Shutdown," *Philadelphia Inquirer* (21 Mar 2020), A1, A7; Jeff Gamage, Amy S. Rosenberg, and Chris Palmer, "Region, Nation Gird for Worse," *Philadelphia Inquirer* (23 Mar 2020), A1, A6; Justine McDaniel, Pranshu Verma, and Sean Collins Walsh, "Wolf Expands Order to Stay Home," *Philadelphia Inquirer* (24 Mar 2020), A1, A14.

[13] Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022

office equipment, file cabinets, and small items to a platform constructed after the Interpretive Center opened. Located in the northern end of the Old Mill House, the roughly 425-square-foot platform is elevated six feet above the main floor, higher than all but the worst of flood waters.

If a more severe flood event is in view, the Water Department's Maintenance Superintendent will send a crew of between 20 and 30 workers to dismantle and move sensitive exhibit components and major equipment like desks, copiers, printers, refrigerators, and science equipment to the platform, as well as to raise other exhibit components using the hoist system. If water is expected to rise above the level of the main floor, the facility manager shuts down the HVAC system as well as the gas, water, and electrical utilities. The goal is to have everything moved out of harm's way and buttoned down within two hours of notification.

After a flood subsides, the buildings, exhibit components, and equipment must be inspected and clean-up initiated. Within a short timeframe—24 hours at most—the riverside balcony doors can be opened and much of the leftover silt and debris hosed out into the river. Any longer and the Pennsylvania Department of Environmental Protection requires testing of the remaining muck for contaminants. The allowable time horizon is affected by any sewage that may have been known to have been released into the river by a combined storm and sanitary sewer system upstream. This is all coordinated with the Water Department's hazardous materials unit.

In any event, all surfaces are cleaned and disinfected with eco-friendly products.[14] Once personnel can walk around freely, the various utility systems—electrical wiring and outlets, data

[14] Garrett Selby, Tenant Liaison and Facility Manager, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 31 Jan 2022. One of the products employed is Dawn dishwashing liquid, long used to clean contaminated wildlife and soiled surfaces in environmentally sensitive areas. See "Dawn Helps Save Wildlife," *Procter & Gamble Company* (2022), <https://dawn-dish.com/en-us/dawn-saves-wildlife>, accessed 4 Sep 2022.

cabling and jacks, plumbing, air handling and ductwork—are restored to operating condition and tested. Finally, the utilities are restarted and the HVAC system is powered back up.[15]

The floor of the lower level of the Engine House and the floors of the riverside balconies are lower than the main floor, 5½ feet and 4⅓ feet lower respectively. If water is safely projected to flood only these areas—so-called "localized flooding"—clean-up is relatively quick and easy. In fact, the Interpretive Center often remains open during this type of event. The high water is even used as a teaching tool and visitors are shown how the center prepares for, recovers from, and cleans up after a flood event. When the water level is projected to rise above the main floor—"major flooding"—the facility is closed to the public and the more extensive portions of the flood response plan are implemented.

Although there have been times that some type of flood event was anticipated and nothing came of it, the flood response plan has had to be implemented on a few occasions ahead of genuine flooding. In addition to the flooding that delayed the Interpretive Center's opening for five weeks in the fall of 2003, notable flooding that caused temporary closure and clean-up occurred in August and September of 2011 due to Hurricane Irene[16] and an unnamed storm,[17] in May 2014 due to an unnamed storm that stalled over the region,[18] and in August 2020 due to

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[15] Philadelphia Water Department, *Fairmount Water Works Flood Management Plan* (Oct 1996, rev. Aug 2018); Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022; Garrett Selby, Tenant Liaison and Facility Manager, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 31 Jan 2022.

[16] Will Bunch, "Category Feh," *Philadelphia Daily News* (29 Aug 2011), 3f, 6.

[17] "Scenes From (After) a Storm," *Watersheds Blog, Philadelphia Water Department* (9 Sep 2011), <http://archive.phillywatersheds.org/blog/scenes-after-storm-fairmount-water-works>, accessed 31 Jul 2022.

[18] "All About the Flood at the FWW," *Fairmount Water Works Interpretive Center* (26 May 2014), <https://fairmountwaterworks.org/blog/2014/05/all-about-the-flood-at-the-fww/>, accessed 31 Jul 2022; Christine Fisher, "Fairmount Water Works Still Wringing Out from Flood," *Philadelphia Inquirer* (28 May 2014), <www.inquirer.com/philly/news/Fairmount_Water_Works_still_wringing_out_from_flood.html>, accessed 31 Jul 2022; "A Year Ago…," *Fairmount Water Works Interpretive Center* (1 May 2015), <https://fairmountwaterworks.org/blog/2015/05/a-year-ago/>, accessed 31 Jul 2022.

Hurricane Isaias.[19] These three storms caused the Schuylkill River to crest above Fairmount Dam 13.56 feet, 13.91 feet, and 13.38 feet, respectively.[20]

Just as the COVID-19 pandemic began to abate and social patterns started to return to anything that could be considered normal, the worst flooding in living memory washed down the Schuylkill River.[21] Hurricane Ida swept through the area on Wednesday, 1 September 2021, causing the Schuylkill River to crest at 16.35 feet above Fairmount Dam during the next morning.[22] This was significantly higher than either the 14.32-foot crest of Hurricane Diane in 1955[23] or the 14.65-foot crest of Hurricane Agnes in 1972.[24] In fact, this was the worst flooding since the river had crested at 17 feet during the legendary Saxby Gale Hurricane in 1869.[25]

The Category 4 hurricane dropped three inches of rain per hour over southeastern Pennsylvania[26] that covered areas that hadn't seen flooding in living memory.[27] Floodwaters inundated the below-grade Vine Street Expressway (Interstate 676), for example, submerging

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[19] Anthony R. Wood, Erin McCarthy, Frank Kummer, and Viny Vella, "Wet and Powerless," *Philadelphia Inquirer* (5 Aug 2020), A1, A6.

[20] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 14 Jan 2020); National Weather Service, *Categorical Floods: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 15 Jan 2020); National Weather Service, *Historical Floods: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 21 Jan 2020). For entry for 4 Aug 2020, see "Schuylkill River at Philadelphia, PA," *U.S. Geological Survey* (2021), <https://waterdata.usgs.gov/monitoring-location/01474500/#parameterCode=00065&period=P365D&compare=true >, accessed 16 Dec 2021.

[21] Anthony R. Wood and Robert Moran, "Ida Rather You Stayed Away," *Philadelphia Daily News* (2 Sep 2021), A3, A20

[22] "Schuylkill River at Philadelphia, PA," *U.S. Geological Survey* (2021), <https://waterdata.usgs.gov/monitoring-location/01474500/#parameterCode=00065&period=P365D&compare=true >, accessed 16 Dec 2021.

[23] National Weather Service, *Top 10 Highest Historical Crests: Schuylkill River at Philadelphia, PA* (Washington, D.C.: 14 Jan 2020); National Weather Service, *Categorical Floods: Schuylkill River at Philadelphia, PA* (15 Jan 2020); National Weather Service, *Historical Floods: Schuylkill River at Philadelphia, PA* (21 Jan 2020).

[24] U.S. Geological Survey and National Oceanic and Atmospheric Administration, *Hurricane Agnes Rainfall and Floods, June–July 1972/Geological Survey Professional Paper 924* (Washington, D.C.: 1975), 99.

[25] U.S. Geological Survey and National Oceanic and Atmospheric Administration, *Hurricane Agnes Rainfall and Floods, June–July 1972/Geological Survey Professional Paper 924* (Washington, D.C.: 1975), 99; Anthony R. Wood, "The Schuylkill Flood That Outdid Ida's Wrath," *Philadelphia Inquirer* (4 Oct 2021), B1, B4.

[26] John L. Beven II, et al., *Tropical Cyclone Report: Hurricane Ida* (National Hurricane Center, National Oceanic and Atmospheric Administration, 4 Apr 2022), 10.

[27] Laura McCrystal, Andrew Seidman, and Allison Steele, "The Afterwrath," *Philadelphia Daily News* (5 Sep 2021), A3f.

and knocking out the electrical control system for drainage pumps, and burying a mile-long length of the Center City highway under 15 feet of water.[28] High winds and five tornedoes in the area caused destruction as well.[29]

Until this time, the worst-case scenario called for all removeable equipment and sensitive components to be moved to the platform in the unoccupied portion of the Old Mill House. Floodwater had never risen above the level of the platform, nor was it expected to. During Ida, however, the water rose so fast[30] that there was no time to move very much to the platform. Worse, for the first time water eventually rose to just two feet below the ceiling—over five feet above the platform—so that much of what was moved there was ruined.

Hurricane Ida was a significant blow to the Interpretive Center. Much was lost—office desks and chairs, file cabinets and their contents, a copier, a microwave oven, two refrigerators, a six-port radio charger, nearly all of the science equipment, and sundry supplies. Ida demonstrated that under the right conditions, floodwater can rise as high as the ceiling and quickly.

In response, Interpretive Center staff have modified the flood management plan to include moving equipment and exhibit components completely offsite. A significant complication, however, is the limited lift capacity. There is a small passenger elevator in the Engine House that has a capacity of 150 pounds above the weight of any people. A freight elevator has been constructed within the footprint of the North Entrance House; it has a higher

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[28] Anthony R. Wood, Erin McCarthy, Vinnie Vella, and Oona Good-Smith, "Swamped," *Philadelphia Inquirer* (3 Sep 2021), A1, A6.

[29] John L. Beven II, et al., *Tropical Cyclone Report: Hurricane Ida* (National Hurricane Center, National Oceanic and Atmospheric Administration, 4 Apr 2022), 11. That the Old Mill House and New Mill House haven't budged under the hydrodynamic assault of the numerous flood events since their completion is a testimony to the engineering skill of their designers, Frederick Graff, Frederic Graff, Jr., and Henry P. M. Birkinbine.

[30] Justin McDaniel, Ellie Rushing, and Oona Goodin-Smith, "Floodwaters 'Just Came Too Fast,'" *Philadelphia Daily News* (3 Sep 2021), A7f; Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022; Garrett Selby, Tenant Liaison and Facility Manager, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 31 Jan 2022.

weight capacity than the passenger elevator, but it is smaller than a typical elevator of its type and the size of anything lifted by it is constrained by the relatively tight dimensions of the portal doorway leading out to the deck of the Old Mill House. In fact, anything removeable must fit through the portals of the Entrance Houses. Because of these constraints and complications, the members of the Interpretive Center staff have been forced to prioritize which items to move and which items to sacrifice and later replace.

Two factors, however, did work in favor of the Interpretive Center during the most recent flooding. The staff had switched from desktop computers to laptops two years prior. This has allowed all involved to help restore the operation of the Interpretive Center either in person or remotely as necessary, without the loss of electronic files. Just as significant, many of the exhibit components, recall, were designed to be submerged and buffeted by floodwater and light debris. Some 20 years after initial installation, these original components are in remarkable condition; some, like the interpretive history panels, look practically untouched.[31]

Flooding takes a financial toll nonetheless. The City of Philadelphia had purchased flood insurance after the recovery from Hurricane Sandy in 2012; the policy is administered by the city's Department of Risk Management. The insurance covers only the structures and infrastructure of the Fairmount Water Works buildings, however, not the buildings' contents. Because of this, the Interpretive Center was unable to recover the costs of any of the lost equipment or damaged exhibits. Because the insurance policy covers infrastructure, though, Philadelphia Parks & Recreation was able to settle a claim for $186,000 to pay for the restoration

[31] "Fairmount Water Works Pledges Restoration and Resiliency in Wake of Historic Flooding," *Fairmount Water Works Interpretive Center* (13 Dec 2021), <https://fairmountwaterworks.org/blog/2021/12/fairmount-water-works-pledges-restoration-and-resiliency-in-wake-of-historic-flooding/>, accessed 13 Jan 2022; Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022; Garrett Selby, Tenant Liaison and Facility Manager, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 31 Jan 2022.

of utilities and the reinstallation of the electrical system and data cabling along the ceiling instead of the lower walls.[32]

Even elevated electrical system components, however, would have been affected by Ida. The board of the Fund for the Water Works is studying ways to make the infrastructure more robust. Various types of alternative materials, like insulated wiring and data cables hardened against flood effects, are also being studied. To fund these efforts, the City of Philadelphia is applying for grants from the Federal Emergency Management Agency and the Pennsylvania Emergency Management Agency.[33]

Although increased resilience is necessary, and no doubt will be achieved, experience has taught that conditions within the Old Mill House are simply not conducive to maintaining effective office operation and functions. It is always either too hot, too cold, too damp, or too "something." Mildew is a problem. More than difficult, it is unhealthy. Because of this, planning is underway to permanently move the staff offices to a nearby offsite location. Interpretive Center staff will continue to work onsite when needed for programs or activities. This will support the health of the staff members while at the same time reduce the risk of the loss of equipment and working files due to flooding.[34]

It took over six months—until 22 March 2022—for the Interpretive Center to recover and reopen in stages.[35] Most of the interactive exhibits, however, have still been undergoing offsite reconstruction and renewal over a year after the flooding. Nevertheless, the Interpretive Center

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[32] Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022.

[33] Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022; Garrett Selby, Tenant Liaison and Facility Manager, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 31 Jan 2022.

[34] Karen Young, Director, Fairmount Water Works Interpretive Center, telephone interview with author-editor, 6 Jan 2022.

[35] "Fairmount Water Works Pledges Restoration and Resiliency in Wake of Historic Flooding," *Fairmount Water Works Interpretive Center* (13 Dec 2021). The *Pool* exhibit opened in the New Mill House on the same day.

currently sees approximately 25,000 visitors annually, including about 7,000 school children, and continues to host a variety of exhibits and activities for both kids and adults, in support of its water education mission.

An ongoing exhibit called *Pool: A Social History of Segregation,* opened when the Interpretive Center reopened. Appropriately located in the New Mill House where the pool had been, the 4,700-square-foot installation, designed by Victoria Prizzia and her team at Habithèque, Inc., is an exploration of the history of segregated swimming in America and its continuing effect on disparate drowning rates between the races today.[36] A series of music events and food concessions are associated with the exhibit as well.[37]

The *Pool* exhibit was intended to debut the day after Ida hit, but the flooding caused a disappointing delay. The electronics were removed and the submergible components left in place where they survived quite well. After the clean-up crew did their work, a visitor would never suspect a flood had ever occurred. After everything was reassembled, however, the exhibit still had to wait for the opening of the Interpretive Center.[38]

In addition to education, genuine science with real-world application is being conducted. In collaboration with the Partnership for the Delaware Estuary and Drexel University's Academy of Natural Sciences, the Interpretive Center began a program to breed freshwater mussels and seed them in water courses around the Philadelphia region.[39]

Freshwater mussels are a beneficial component of a healthy aquatic ecosystem. Growing to a few inches across, a healthy adult mussel can filter approximately 20 gallons of water every

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[36] *Pool: A Social History of Segregation* (2022), <www.poolphl.com>, accessed 9 Jul 2022.
[37] *Splash/Concessions*, event flyer (Fairmount Water Works Interpretive Center, Summer 2022).
[38] Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021.
[39] "Freshwater Mussel Hatchery," *Fairmount Water Works Interpretive Center* (2022), <https://fairmountwaterworks.org/visit/freshwater-mussel-hatchery/>, accessed 12 Jul 2022.

day. With nearly three hundred species, North America has the greatest diversity of freshwater mussels in the world. There are over 60 species in Pennsylvania alone, one of the highest numbers in the United States. Though once plentiful, pollution has rendered many species endangered and in the Philadelphia region some have disappeared.[40] Because area waterways have become cleaner in recent years, however, biologists have been considering how to increase the local freshwater mussel population.

The Philadelphia Water Department began partnering with scientists in 2014 to determine the best way forward[41] and in 2017 created a freshwater mussel hatchery in the lower level of the Engine House.[42] Funded by the Water Department and the Pew Center for Arts and Heritage, the hatchery began operating in mid-February.[43]

Freshwater mussels have a complex life cycle. After a female's eggs are fertilized and transition into larvae called glochidia, they are expelled into the surrounding water when a suitable host fish swims by. The glochidia attach to the gills or skin of the host fish and are carried to other locations where they detach and grow to adulthood. Among the work being performed at the hatchery are experiments to determine the best host fish for different mussel species.[44]

Most of the work in the hatchery takes place in the spring and summer. During this time

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[40] Natural Resources Conservation Service, *Fish and Wildlife Habitat Management Leaflet, No. 46: Native Freshwater Mussels,* (U.S. Department of Agriculture, Jan 2007); Sandy Bauers, "Putting Mussels Back Into Work," *Philadelphia Inquirer* (24 Sep 2014), A3.
[41] Andy Bauers, "Putting Mussels Back Into Work," *Philadelphia Inquirer* (24 Dep 2014), A3.
[42] "Mussel Hatchery Update," *Fairmount Water Works Interpretive Center* (22 May 2017), <https://fairmountwaterworks.org/blog/2017/05/blog-post-mussel-hatchery-update/>, accessed 12 Jul 2022.
[43] "Phila. Shows Off Its Mussels in World's First City-Owned Hatchery," *Berks Community Television* (17 Feb 2017), <https://perma.cc/7CMP-E27H#user-comment-area>, accessed 18 Jul 2022.
[44] "Behind-the-Scenes Science Continues in the Freshwater Mussel Hatchery," *Fairmount Water Works Interpretive Center* (2 Jul 2020), <https://fairmountwaterworks.org/blog/2020/07/freshwater-mussel-hatchery/>, accessed 12 Jul 2022; Lance H. Butler, Senior Scientist, Office of Watersheds, Philadelphia Water Department, personal conversation, 4 Aug 2022.

of the year, visitors can watch as various activities and experiments are performed. At any time, however, visitors can see the equipment station and visit an engaging interactive website where they can learn about the mussel's life cycle and importance and watch videos of the scientists conducting their work and explaining what they are doing.[45]

Hurricane Isaias in 2020 was disruptive to the hatchery, but the sensitive equipment was removed before the worst of the flooding occurred. When Hurricane Ida hit, however, there was insufficient time to remove the hatchery's electronics; they were destroyed and had to be replaced. Most of the components are made of plexiglass and other durable materials, though, and these survived intact. And because the flooding occurred after the breeding season, none of the mussels themselves were present. The hatchery was reconstituted and operated successfully during the spring and summer of 2022.[46]

The hatchery is designed as a pilot project for a larger operation at Bartram's Garden, on the Schuylkill River in Philadelphia, four miles downstream from Fairmount.[47] The hatchery at the Interpretive Center produces between 15,000 and 20,000 mussels each year.[48] The goal at Bartram's Garden is to produce 500,000 annually.[49] That facility is projected to start construction in 2023.[50]

What might the future hold for the Fairmount Water Works? Although further excavation

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[45] *The Mighty Mussel* (2022), <www.mightymussel.com/>, accessed 8 Jul 2022.

[46] Because Hurricane Ida hit after the breeding season, no mussels were present during the flooding. Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021; Lance H. Butler, Senior Scientist, Office of Watersheds, Philadelphia Water Department, personal conversation, 4 Aug 2022.

[47] Frank Kummer, "Area Rivers Eyed for Mussels' Might," *Philadelphia Inquirer* (16 Jan 2019), B2; Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021.

[48] Frank Kummer, "Area Rivers Eyed for Mussels' Might," *Philadelphia Inquirer* (16 Jan 2019), B2.

[49] Frank Kummer, "Area Rivers Eyed for Mussels' Might," *Philadelphia Inquirer* (16 Jan 2019), B2; "Ecosystems Education Center & Freshwater Mussel Hatchery," *Bartram's Garden* (2022), <www.bartramsgarden.org/hatchery/>, accessed 14 Jul 2022.

[50] Caroline Winschel, Director of Development & Communications, Bartram's Garden, telephone interview with author-editor, 20 Jul 2022.

of the Forebay is not currently being actively considered, it is not off the table for the long term. Fortunately, utilities are mostly clustered beneath the Schuylkill River Trail which runs along the far side of the inner Forebay at the base of the cliff. There is a need to better define the Forebay, perhaps by lowering the grade a bit more, but a significant excavation will be up to a future generation.[51]

Within the Interpretive Center, returning mobility to the remaining components of the test turbine is also not currently under consideration. When Christine Matheu and Mary-Scott Cebul crafted the initial concept for the Interpretive Center in 1986, they hired Tom Rick of Manitou Machine Works in Cold Spring, New York, to assess the idea's feasibility. Rick determined that although it would require disassembly and reconditioning of all of the remaining parts, it was possible and would cost, at that time, between $75,000 and $150,000,[52] depending upon whether the work could be done in the shop had to be done onsite.[53] Because many of the components would require machining to bring them within operating tolerances, however, this would destroy some of the original fabric of the artifact and the turbine has been allowed to remain as is.

Expansion of the Interpretive Center into more of the Old Mill House is more certain. The current footprint cannot accommodate large school groups or moderately sized conferences and staff and educators need additional professional and prep space. The *Pool* exhibit, while not permanent, currently occupies the interior of the New Mill House and visitors access the space by walking through the "unoccupied" portion of the Old Mill House. Ways of further utilizing

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[51] Claire Donato, Senior Associate and Director of Restoration, Mark B. Thompson Associates LLC, telephone interview with author-editor, 4 Aug 2021.
[52] The equivalent of approximately $202,600–405,200 million in 2022. Were it to be accomplished today, it would cost considerably more than that.
[53] Matheu Cebul & Associates, *Design for an Interpretive Center at the Fairmount Waterworks: Appendix to Final Report*, Section B, Turbine Restoration Report (30 Jun 1986).

this portion of the Old Mill House are being studied.[54]

Plans are underway to incorporate an acrylic reproduction of a breast wheel in the space where Wheel 1 had been.[55] Empty since 1883,[56] the space has featured a moving image projected onto a scrim since the opening of the Interpretive Center in 2003. A moving physical representation, however, is desired in order to give visitors a sense of just how large and imposing the 15-foot-diameter, 15-foot-wide breast wheels were.[57] Acrylic resin will be used because of cost. A study conducted in 2000 estimated that a reproduction using historically accurate materials would cost—at that time—nearly $900,000.[58] An acrylic reproduction is projected to be a more affordable $200,000.[59]

It has long been known that people are naturally drawn to water features. Herman Melville, for instance, began his famous 1851 novel *Moby Dick* by discoursing upon this observation. A visitor might expect the Fairmount Water Works to be a good location to connect with the Schuylkill River, yet depending on when they visit, they might find it surprisingly difficult to do so in a programmed way. Plans for a Floating Water Workshop aim to change that. Designed by the Habithèque team and funded by a $3 million grant from the Commonwealth of Pennsylvania,[60] the 5,400-square-foot, open-air facility is planned for the eastern shore of the

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[54] Claire Donato, Senior Associate and Director of Restoration, Mark B. Thompson Associates LLC, telephone interview with author-editor, 4 Aug 2021; Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021.

[55] Original designation. When the system of seven turbines and two remaining breast wheels was renumbered in 1872, Wheel 1 (the first breast wheel) was re-designated Wheel 2 and the test turbine (the remnants of which survive today in the lower level of the Engine House) was re-designated Wheel 1.

[56] Water Department, *Chief Engineer's 1883 Annual Report* (Apr 1884), 98. Wheel No. 1 (renumbered No. 2 c.1872) ceased operating in 1872 and was removed in 1883.

[57] All of the breast wheels were 15 feet wide. Wheel 1 was 15 feet in diameter. Three others were 16 feet in diameter and four were 18 feet in diameter.

[58] John Bowie Associates, *Research and Design of the Breast-Type Wheel Assembly for the Reconstruction of Wheel No. 1* (23 Jun 2000), 9. The amount was the equivalent of approximately $1.5 million in 2022.

[59] Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021.

[60] The grant was awarded by the Redevelopment Assistance Capital Program (RACP), a Pennsylvania state funding program for economic, cultural, civic, recreational, and historical improvement projects that have a regional scope.

river just below the Spring Garden Street and Martin Luther King, Jr., bridges. While not located at the Fairmount Water Works itself, the project is associated with the Interpretive Center and its water education mission. Floating on the surface of the water while connected to the shore by two gangways, it is intended to get people out onto the Schuylkill River and help them engage with it.

Like the Interpretive Center itself, the workshop is designed to be entertaining and educational at the same time. It will be open to walk-on visitors and will feature scheduled educational programs and special events and performances. Multi-media activities will provide opportunities to interact with aquatic plants and animals and engage in water play. Boat access has also been incorporated in the design. This would finally allow for the development of long-sought collaborative programming with other institutions like Bartram's Garden, using the boat docks constructed there and in Center City by the Schuylkill River Development Corporation in 2005.[61] Construction is projected to begin in 2024.[62]

The Interpretive Center is working toward becoming a regional collection point for urban watershed research data so that the effectiveness of innovative water management tools and solutions can be more easily monitored and evaluated. Over the next few years, it is also seeking to strengthen its role as an environmental education hub, partnering with the nearby Franklin Institute, Academy of Natural Sciences, Discovery Center, and Bartram's Garden. Each of the institutions can leverage each other's programs so that they all can become part of a larger

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See "RACP," *Office of the Budget, Commonwealth of Pennsylvania* (2022), <www.budget.pa.gov/Programs/RACP/Pages/Main%20Page.aspx>, accessed 13 Jan 2022.

[61] Bob Warner, "Ed Bacon's Field of Dreams," *Philadelphia Daily News* (8 Jan 1993), 19f; Ron Goldwyn, "Link to New Park," *Philadelphia Daily News* (15 Jun 2004), R-9.

[62] "The Fund for the Water Works Awarded $3M State Grant for 'Floating Water Workshop,'" *Fairmount Water Works Interpretive Center* (4 Jan 2022), <https://fairmountwaterworks.org/blog/2022/01/the-fund-for-the-water-works-awarded-3m-state-grant-for-floating-water-workshop/>, accessed 12 Jul 2022; "The Floating Water Workshop," Habithèque (2022), <www.habitheque.com/floatingwaterworkshop>, accessed 12 Jul 2022; Victoria Prizzia, Principal, Habithèque Inc, telephone interview with author-editor, 12 Oct 2021.

environmental education tourist destination.[63]

Fairmount's commercial activity has challenges as well. The Cescaphe Event Group has been operating in the Engine House and on the decks of the Old and New Mill Houses since 2015. One of six facilities managed by the company, it solely operates for private events like weddings, parties, and corporate engagements. During an event on the deck, the only exterior portions of the buildings that are generally open to the casual visitor are the Mound Dam, Pier, and Eagle Pavilion. The Engine House is almost never open to the casual visitor and the Caretaker's House has been converted into a closed bridal suite with a private veranda, visitors unwelcome.

When an event is not being held, the Engine House and Caretaker's House remain closed. Although members of the public may freely wander the decks of the Mill Houses, much of the area is hidden behind tents, stacks of chairs, and portable equipment, including two dressed-up porta-potties next to the Forebay Bridge. Access to much of the riverside balustrade along the Old Mill House deck is blocked by equipment storage.

The deck structures of the Old Mill House in particular—the Pavilion, North Entrance House, and South Entrance House—are hidden behind awnings, partitions, equipment storage, and a long, covered walkway from the Engine House across the deck of the Old House to the tent on the deck of the New Mill House. This tends to give the impression that these areas are closed to the public even when they are open. In 2022, a large tent structure was erected on the deck of the New Mill House. Occupying 70 percent of the deck space, it rose to over ten feet above the peak of the next-door Watering Committee Building, higher even than the top of the Pavilion.[64]

[63] "Mission and Values," *Fairmount Water Works Interpretive Center* (2022), <https://fairmountwaterworks.org/about/mission/>, accessed 13 Jan 2022; Joanne Dahme, former General Manager, Public Affairs, Philadelphia Water Department, telephone interview with author-editor, 19 Jul 2021.

[64] Personal measurement by the editor-author.

This is somewhat ironic. Recall that the 1989 restaurant proposal from The Chart House chain was eventually scuttled in part because too much of the deck space would have been occupied and public access overly restricted. In 2004, a proposed addition to the Engine House that was perceived as intrusive was the very thing that caused Catelli's restaurant proposal to founder, but that modification was comparatively minor.

Although a tent was an initial response to the public's fear of doing anything indoors during the COVID pandemic, the enormity of the structure present during the 2022 season was clearly a misstep. By the spring of 2023, however, it had been replaced with a more traditional structure with a smaller profile.

This illustrates the genuine challenge of maintaining the Fairmount Water Works. Any historic site needs to be active in some way to prevent it from falling into disrepair. And maintaining the buildings of the Fairmount Water Works is exceedingly expensive. Because of these two factors, there will always need to be some form of concession operating there. Philadelphia Parks & Recreation will always face a difficult balancing act between the need for activation and the need for revenue, the need to minimize wear and tear, and the need to maximize access for non-paying members of the public.

This tension is nothing new; it has long been faced by historic sites around the world. At Fairmount itself, the earlier restaurant, a seven-day-a-week operation, was very rough on the buildings, especially within the footprint of the Engine House and Caretaker's House.

Cescaphe's Fairmount concession currently brings in nearly $200,000 per year, all of which goes into a trust account established during the days of the Fairmount Park Commission. Owner Joe Volpe has from time to time also contributed funds toward maintenance beyond the contract stipulation. From the trust account, all of the revenue is spent on maintaining the

Fairmount Water Works. None of it is sent elsewhere.

Revenue from the other concession, Parks on Tap, varies from year to year. The outdoor beer garden, operating among the trees between the Schuylkill River and the *Fountain of the Sea Horses* and on part of the lawn in the area of the Outer Forebay, is highly weather-dependent, but the revenue it generates, like that from Cescaphe, is directed to Fairmount. Parks on Tap operates at numerous locations throughout the Fairmount Park System. Philadelphia Parks and Recreation established a specific fund account, with further sub-accounts for each setup, so that the revenue from each can be allocated back to the location at which it operates.[65]

Fortunately, there are many ways to interact with the Schuylkill River at Fairmount today. Visitors can stroll the South Garden and Esplanade, walk the mostly accessible (if rather cluttered) decks of the Old Mill House and New Mill House, amble around the Mound Dam, Eagle Pavilion, and Pier, fish from the downstream side of the Mound Dam, explore the

Fairmount Water Works

The restoration of an historic building complex like the Fairmount Water Works is never truly complete. The work of re-adapting, re-activating, and maintaining Fairmount is by its very nature difficult, challenging, rewarding, and unending. Numerous industrious and talented people continue to work together to ensure that the Fairmount Water Works remains available for the enjoyment and education of the public far into the future.

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Atop the Mercury Pavilion, *Mercury* is depicted as delivering his leather purse with a

[65] Robert Allen, Director of Property and Concession Management, Philadelphia Parks & Recreation, online interview with author-editor, 26 Jan 2023.

message to the gods, but to the modern eye looks amusingly like he is taking a selfie. In the South Garden, *Allegory of the Schuylkill River* beckons visitors to pause and relax awhile. So that is where we will end our journey.

The Fairmount Water Works is a wondrous place. Its history is full of hard work and achievement, of frustration and glory, spanning more than two centuries of history. Visit Fairmount if you have the opportunity. Amble over to the balustrade at river's edge. Explore the Interpretive Center. Climb one of the Cliffside Paths. Follow *Mercury's* example, perhaps, and take a selfie of your own. Or heed the dulcet call of *Allegory of the Schuylkill River* and simply take a moment to relax in the South Garden.

Become a part of its magnificent story yourself.

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